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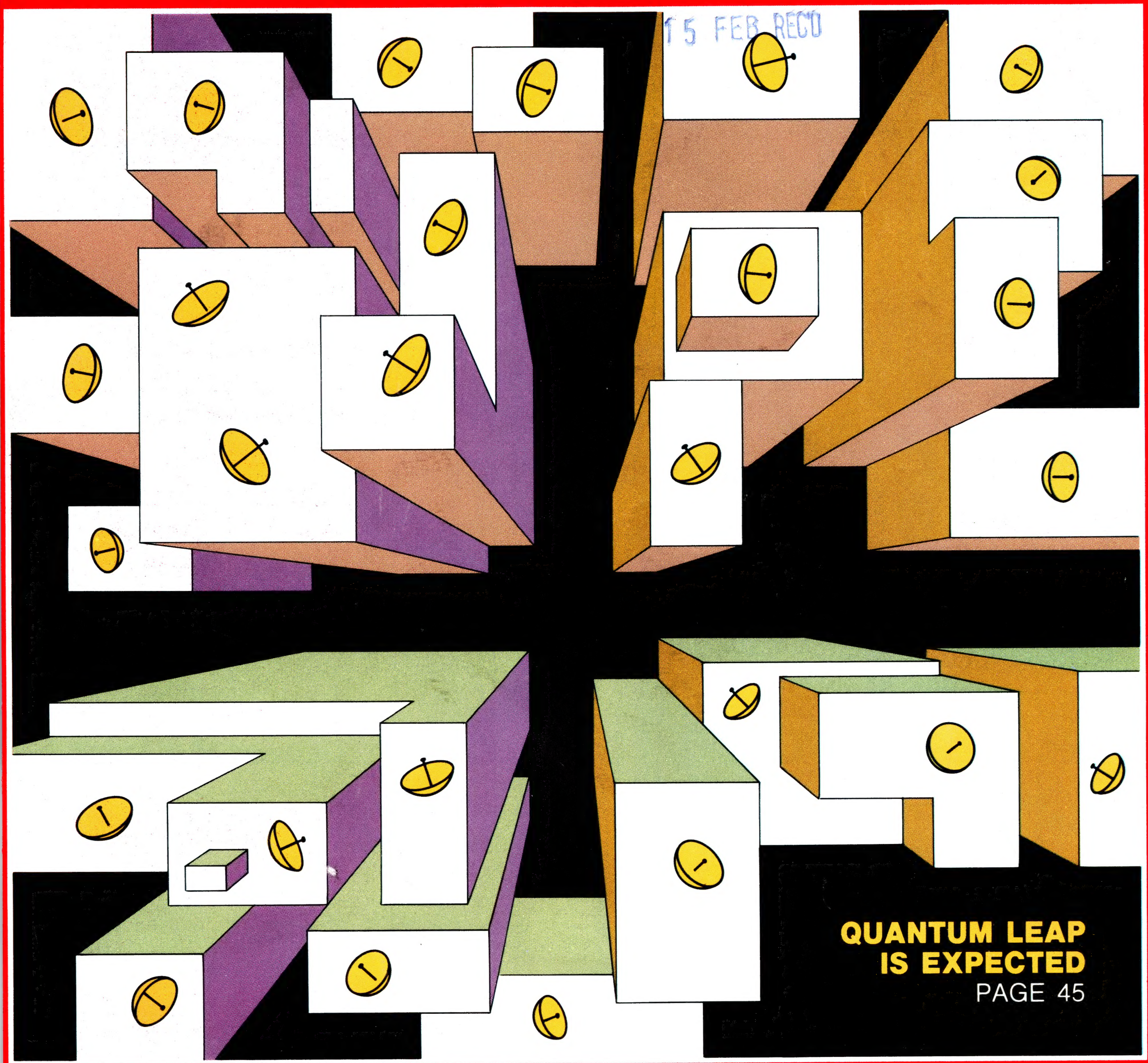

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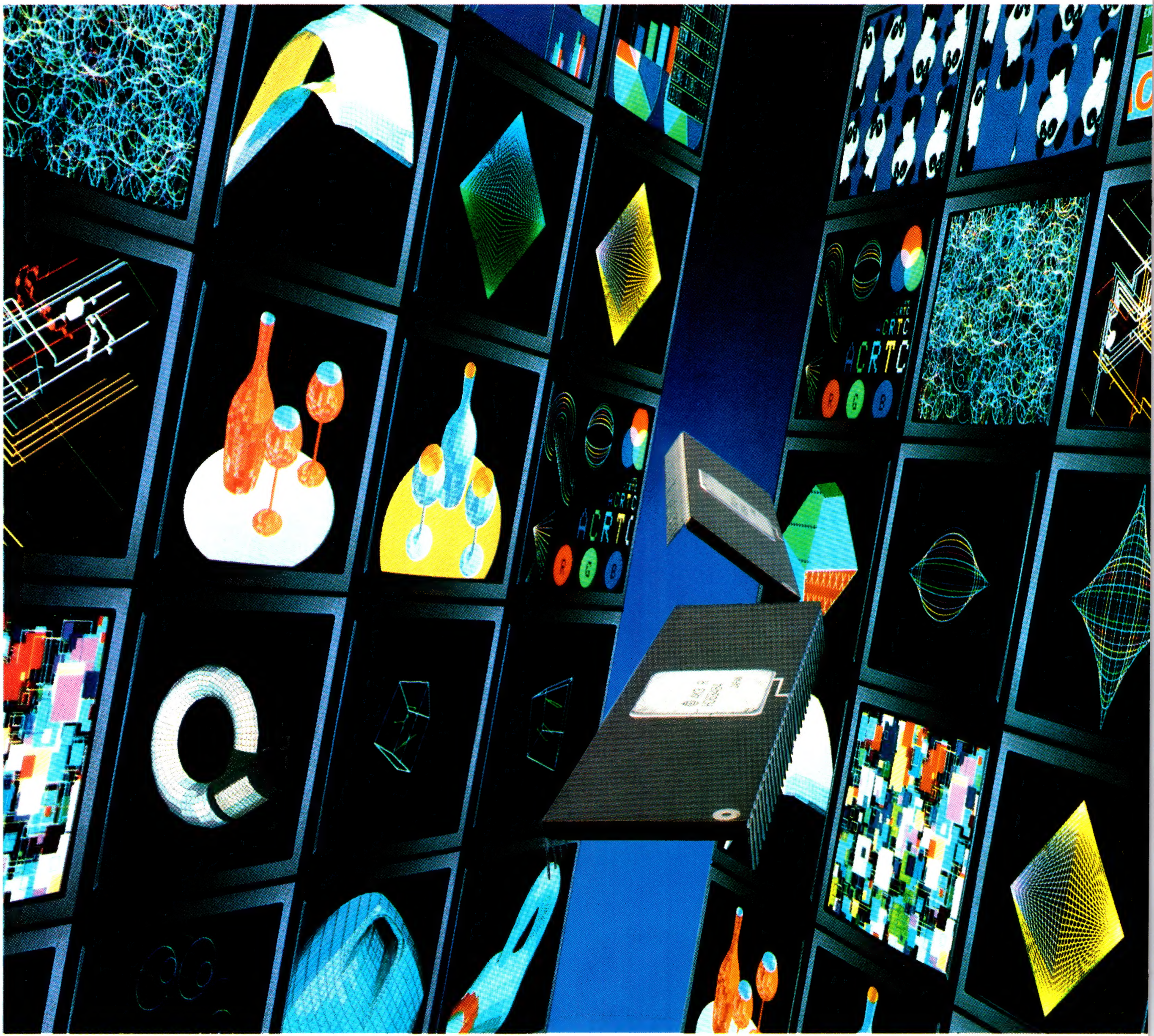

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Next ElectronicsWeek

Is it time to change the way the DOD buys ICs?

For some suppliers of electronic components to the U.S. military, the procurement process involves a complex series of decisions and demands that are growing increasingly frustrating. In a major article in the next *ElectronicsWeek*—a blockbuster double issue that will appear Feb. 4 (there will be no Jan. 28 issue)—Ed Macaruso, the military sales manager at Signetics Corp., says, "It's time for the Department of Defense to re-evaluate the way it acquires integrated circuits for use in crucial military systems." Find out what he wants the Pentagon to do, as well was what some of his peers in the industry think of the military procurement situation.

Where AI is and where it's coming from

Another part of the big double package, which will feature an augmented lineup of special technology reports, will be an exploration of the frontiers of artificial intelligence. Although AI technology won't do all the things some overenthusiastic supporters have claimed, it still promises to be a powerful tool for solving realistic problems and extending the possibilities of computer technology. And the commercial prospects look good. But there is one important qualification: computer systems that can match, let alone surpass, the human ability to reason are not on the horizon—nor are they likely to appear in the near future. Read about it in the Feb. 4 double issue.

ElectronicsWeek index available

An index of the editorial material that *Electronics* and *ElectronicsWeek* ran during 1984 (Vol. 57) will soon be available. To get your copy, just circle No. 475 on the reader service card. If you no longer have the card, order the index by letter from Kathleen Morgan, *ElectronicsWeek,* 1221 Avenue of the Americas, New York, N.Y. 10020. The 1984 index is free of charge. Those for earlier years may be ordered from our reprint department for $4 each.

January 21, 1985 Volume 58, Number 4
103,421 copies of this issue printed

ElectronicsWeek (ISSN 0748-3252). Published weekly by McGraw-Hill Inc. Founder: James H. McGraw 1860-1948. Publication office: 1221 Avenue of the Americas, N. Y., N. Y. 10020; second class postage paid at New York, New York and additional mailing offices. Postage paid at Montreal, P. Q. Registration Number 9034.

Executive, editorial, circulation, and advertising addresses: ElectronicsWeek, McGraw-Hill Building, 1221 Avenue of the Americas, New York, N. Y. 10020. Telephone (212) 512-2000. Teletype 12-7960 TWX 710-581-4879. Cable address: MCGRAWHILLNEWYORK.

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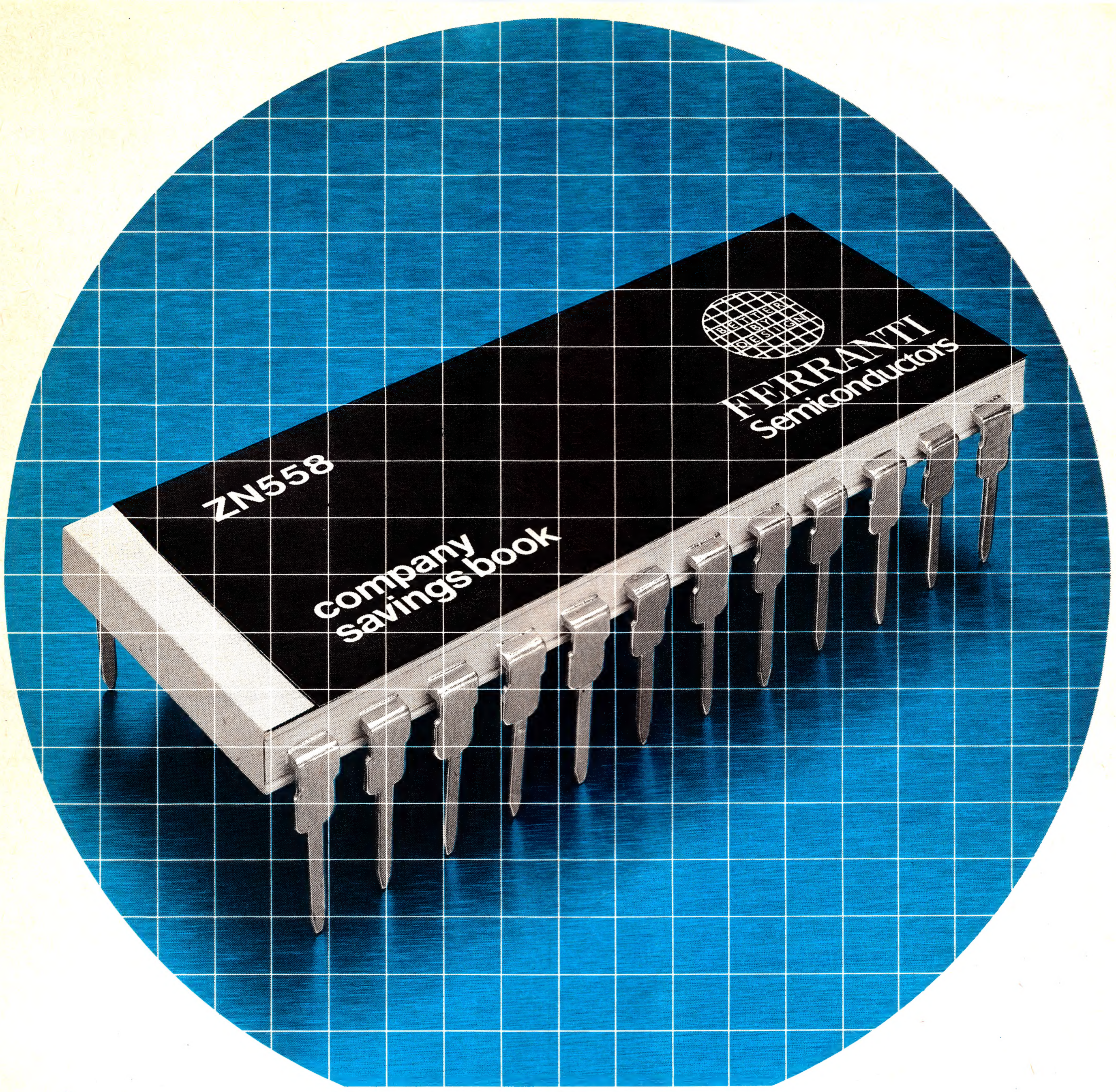

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CRISIS IN E-SCHOOLS

Professor shortfall getting even worse/27

Technology Around the World

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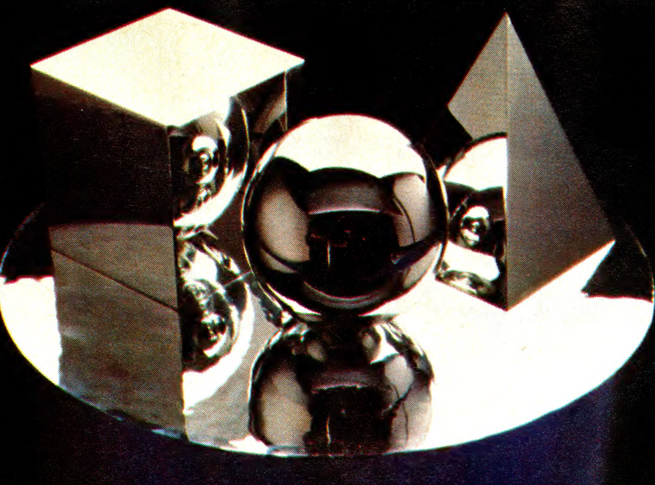

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VOLUME 58, NO. 4 JANUARY 21, 1985

ElectronicsWeek

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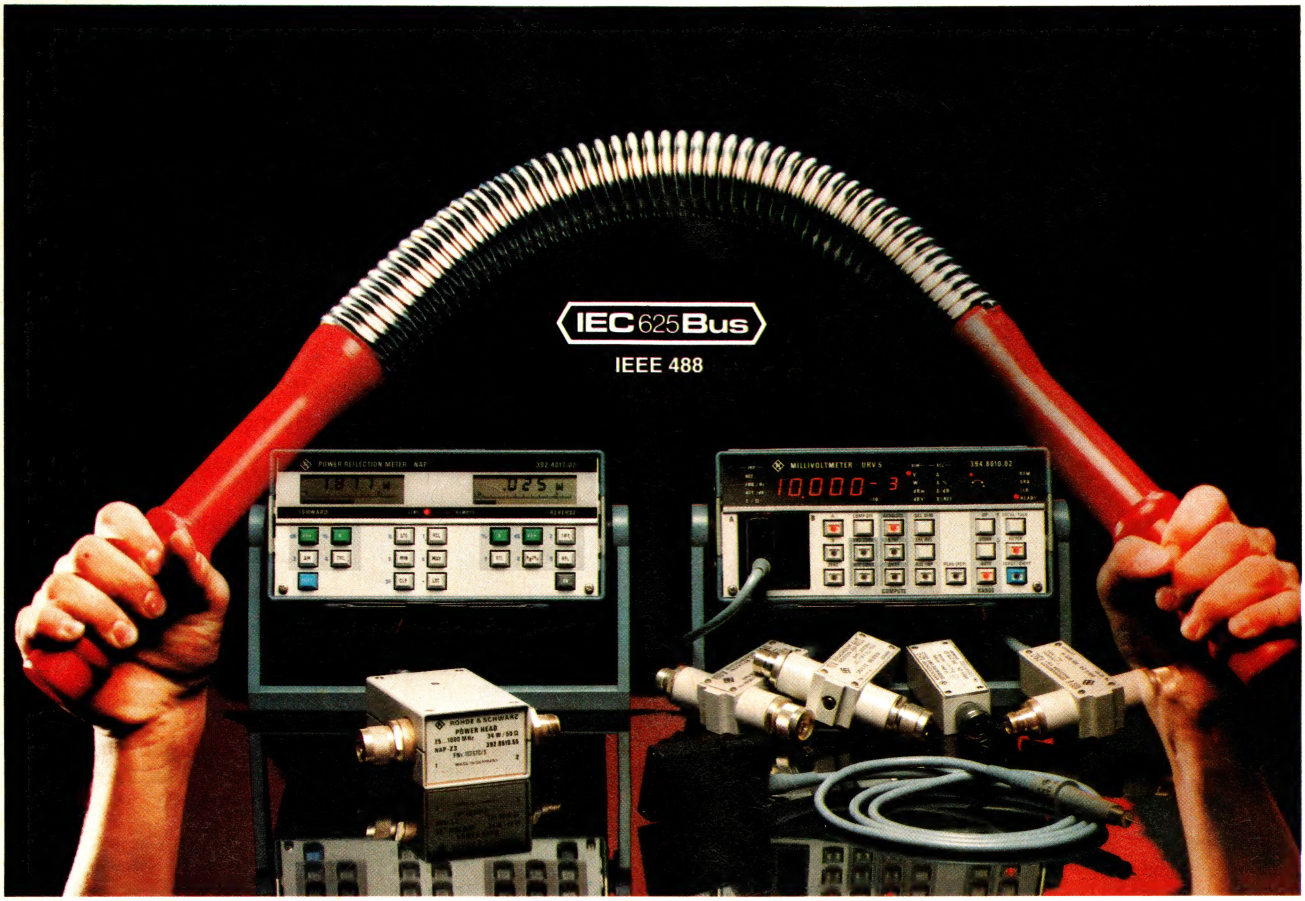

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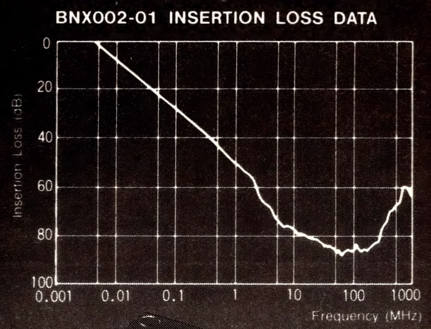

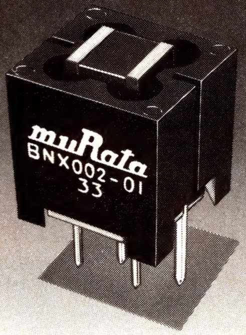

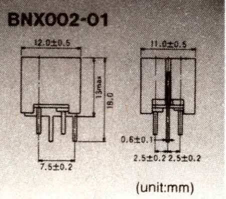

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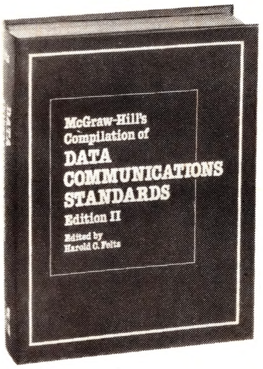
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CHIP MAKERS TRIM STAFFS

Major U.S. semiconductor companies are coping with slumping demand for their products by implementing everything from production shutdowns to hiring freezes. With one exception, the companies surveyed emphasize that they are trying to avoid layoffs. Despite a two-week production shutdown scheduled to start Feb. 11 and a six-month deferment on all pay increases, National Semiconductor Corp. emphasizes that layoffs are a last resort. The chip manufacturer says it foresees an early summer upturn in business and wants its workforce of 9,100 on board then. Hiring and research-and-development spending have remained stable, the company adds, but the possibility of a second shutdown between April 1 and April 14 still looms.

In a December disclosure that 2,000 workers would be laid off, Texas Instruments Inc. anticipated that the workforce reduction would happen sometime this month. TI officials say no layoffs have occurred to date, although the firm still plans to cut 2,000 workers. No specific TI sites have been designated, but assembly plant managers may adjust work schedules depending on product demand. Signetics Corp. currently has no plans for any layoffs but adds that it cannot rule them out in the near term. Except for selective additions of engineers and administrators, Signetics says a hiring freeze is in effect. The firm's current headcount—about 12,000—has been cut by 17%, primarily through attrition. The last time Signetics laid off any workers was in 1982, but since then it has periodically offered four-day workweeks along with bonuses of up to six additional paid vacation days to trim the workforce.

Motorola Inc. says it doesn't foresee any layoffs or production shutdowns but has also had a hiring freeze in place since last November. Motorola will try to avoid future layoffs through staff attrition and a work-sharing program that has allowed it to hold down production costs while keeping its workforce intact. Mostek Corp. has had hiring controls in place for the past six months while seeking to improve overall productivity. It also has no plans for production shutdowns or layoffs and has been selectively hiring design engineers.

But the industry's book-to-bill rate continues to drop

Claiming that business has stabilized, the Semiconductor Industry Association says the book-to-bill ratio for U.S.-, Europe- and Japan-based semiconductor manufacturers dropped to 0.58:1 in December from November's 0.61:1 rate. "The December results suggest that the period of massive order cancellations and reschedules is now over," says SIA president Thomas D. Hinkelman. "Although the situation appears to have stabilized, business continues to be weak." Average monthly bookings for the three months that ended in December slipped 4.3%, he says, while billings increased 19.4%, "reflecting the traditional pattern of a large December shipping month." Looking to the end of this year, Hinkelman notes that the industry's performance in 1985 "will be significantly affected by current inventory levels, a slower rate of growth in semiconductor usage, and price attrition." The SIA estimates the U.S. market for semiconductors "will grow between 2% and 5% in 1985 to not more than $12.2 billion," Hinkelman points out. "This scenario assumes a steep rise in demand from the first half to the second half of 1985."

Adapso files software piracy charges

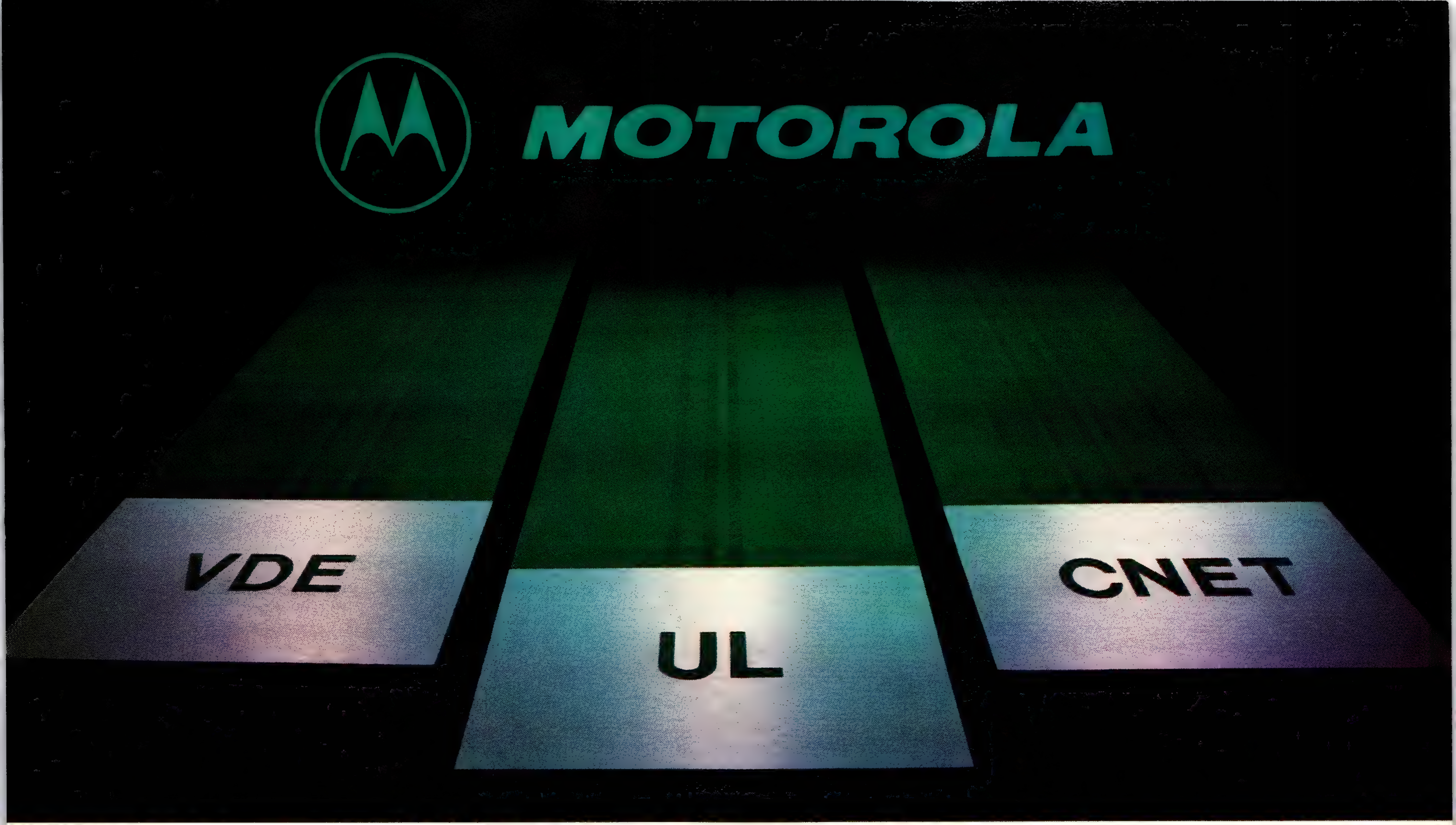
Marking the launch of a nationwide campaign to focus public and congressional attention on software piracy, the Association of Data Processing Service Organizations has filed a $250,000 copyright infringement suit against Wilson Jones Corp., a Chicago supplier of office equipment. The subsidiary of United Brands Inc. has been charged with making and using illegal copies of three popular microcomputer software programs, including Micropro International Corp.'s Wordstar. Adapso also released a draft report outlining the development of hardware to stop unauthorized software copying. The equipment, a commercially available multiple slot box, would fit into a computer's RS-232-C port. A user would get a credit-card-type key when software is purchased and would insert the key into the box to run the package. A user could use the key system to make backup software copies, but only one person could use the software at a time, Adapso says. Adapso estimates that piracy cost the $1.3 billion microcomputer software industry about $325 million in revenues last year.

Motorola unveils floating-point coprocessor for 68020

Adding zip to its 32-bit microprocessor product line, Motorola Inc. last week brought out the MC68881 floating-point coprocessor, which it maintains is twice as fast as any other single-chip math processor. At a 16.67-MHz clock speed, the very large-scale integrated circuit performs an add operation in 2.78 microseconds, Motorola reports, adding that the calculations are made in strict conformance to the latest IEEE floating-point specifications. Designed for use in such products as graphics work stations and computer-aided design and engineering systems, the MC68881 is primarily intended to operate as a closely coupled coprocessor with Motorola's 32-bit MC68020 microprocessor unit. The firm says, however, that the MC68881 can also operate as a memory-mapped peripheral in systems based on any other M68000-family MPU. Fabricated using a 2-micron high-performance CMOS process, the MC68881 contains the equivalent of about 155,000 transistors on a chip measuring 270 by 330 mm. It is packaged in a 68-lead pin grid array with a 1-in.^{2} footprint. Sample quantities will begin to appear in March, and limited production is set to start in July. Sample piece price is $375, Motorola adds.

L.A. to get 56-kb/s switched digital service in spring

Public switched digital service at 56 kb/s will be available in the Los Angeles area by spring, if the California Public Utilities Commission approves the rate schedule that has been filed by Pacific Bell. The provisional two-year tariff, which PacBel has asked to be made effective as of Feb. 1, calls for customers near the central exchange to pay $19.50 for a special line (a two-wire unloaded loop) and $146 per month for the service, plus use charges of $0.12 for the first minute and $0.01 for every six seconds after that. Customers will need two pieces of equipment: a time-compression multiplexer that PacBel will provide for $31.50 a month and terminal interface equipment—a standard RS-449, RS-232-C, or V.35 interface, which must be obtained from another supplier. The service can be used for applications such as high-speed facsimile, full-motion video through compression codecs, bulk data transfers, and encrypted voice and data transmission. The switched 56-kb service is seen as an interim step to a full integrated services digital network (see related story on p. 29).



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VDE 0860	🔴	🔴	🟢	VDE Electronic Household Equipment
VDE 0160	🔴	🔴	🔴	VDE Power Installation with Electr Eqpmt
VDE 0113	🔴	🔴	🔴	VDE Industrial Controls
VDE 0833	🔴	🔴	🔴	VDE Alarm Systems
IEC 380/VDE 0806	🔴	🟢	🟢	IEC Office Machines
IEC 65/VDE 0860	🔴	🔴	🟢	IEC Electronic Household Equipment
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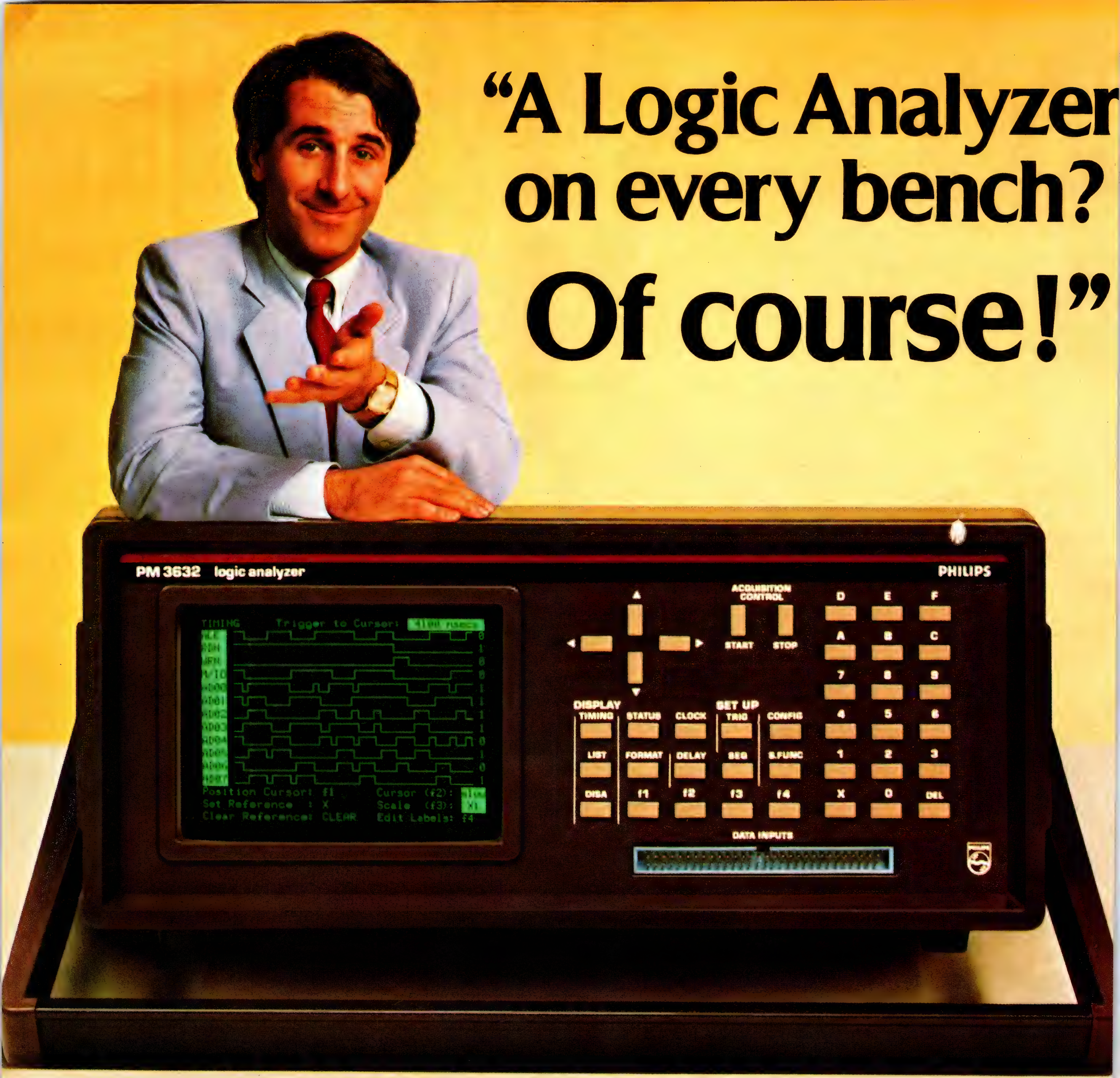

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AROUND THE WORLD

ROBOTS GET SMART IN JAPAN

Intelligent robots match maps to navigate around obstacles in cluttered spaces; one even plays the organ from sheet music

☐ *by Charles L. Cohen*

Tokyo

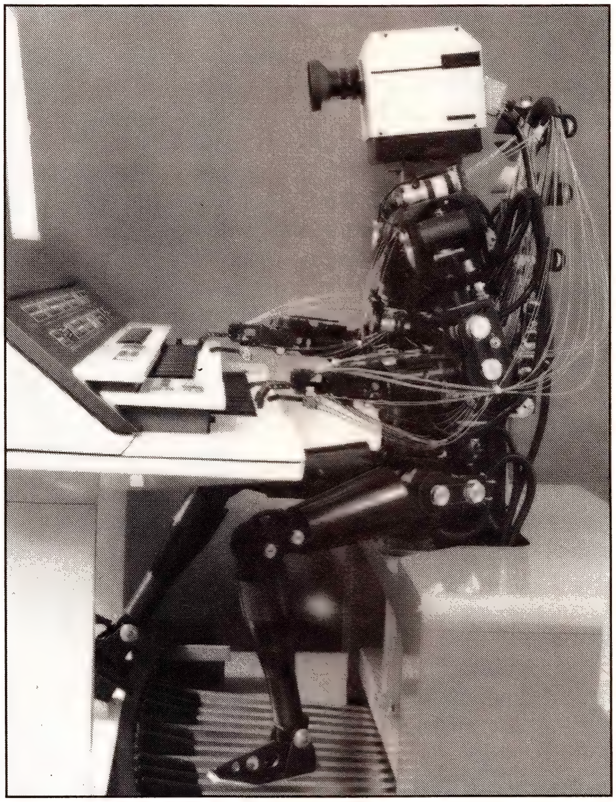
Already the world leader in production-line robots, Japan seems the likely front-runner for the upcoming generation of intelligent mobile robots that will toil in environments too hazardous for humans. And the country's fascination with automatons has sired a striking android—one that will play a standard electric organ at the Science Expo in Tsukuba, which starts a six-month run in mid-March.

Although the organ-playing automaton (see photo, right) is too extravagant for industrial applications, its maker, Sumitomo Electric Co., expects a technological payoff from the design one day. Much closer to getting into industry are experimental robots from two Tokyo firms, Hitachi Ltd. and Toshiba Corp. Their hardware cannot be considered true prototypes, but they nonetheless offer insights into what might be forthcoming in Japanese robot design.

Hitachi's mobile robot crawls around under its own battery power, sometimes at its own discretion. When the terrain is not level, its crawlers adapt to climbing steps or ladders (see photo, upper right, p. 16). Thus through the maps stored in its memory, plus vision over an angle of 162° (about equal to that of humans), the robot can maneuver around small obstacles. Using its arm, which has six degrees of movement, it can open doors or move objects.

Yoshiyuki Nakano, senior chief researcher at the Hitachi Mechanical Engineering Research Laboratory, estimates that it will be four to five years before an entire system of this nature becomes a product.

The system is quite ambitious, with five separate 68000 16-bit processors and 1.8 Mb (more than 220-K bytes) of memory used for map storage and control. Even though it sports a lightweight carbon-fiber-reinforced plastic body, the robot weighs in at 280 kg, largely because of its 24-V storage batteries and configurable crawler mechanism (some versions have legs). The 850-mm-long arm alone weighs 25 kg and can carry a 3-kg load.

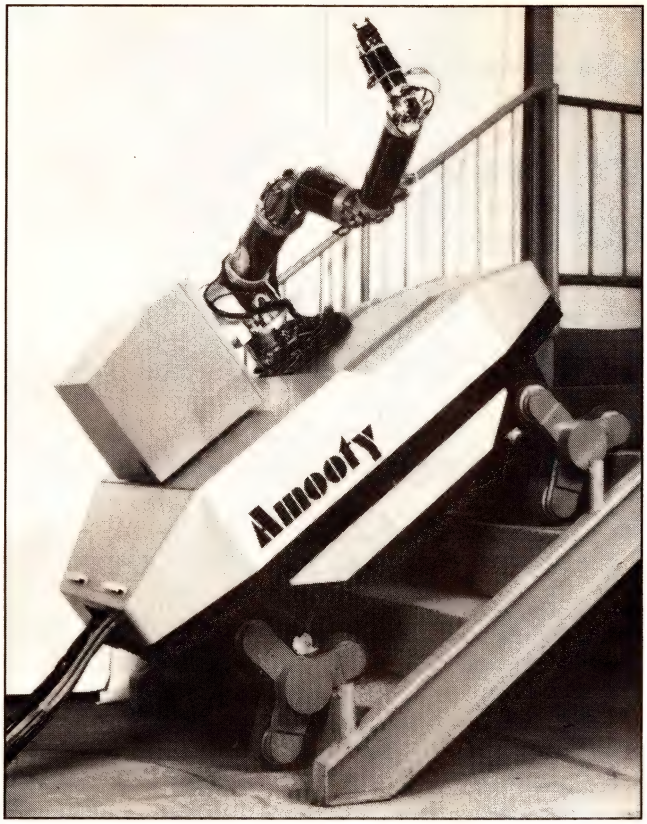


Mechanical musician. Sumitomo's android can bang the keys up to 15 times a second and treadle the pedals as well. It reads music or can play melodies stored in its memory on command.

For operation, the robot has a three-dimensional map in its memory for the area it is to traverse. Pattern processing is used to predict its position. Then an actual map of the immediate surroundings acquired by the vision system, including obstacles, is fed into a different segment of memory.

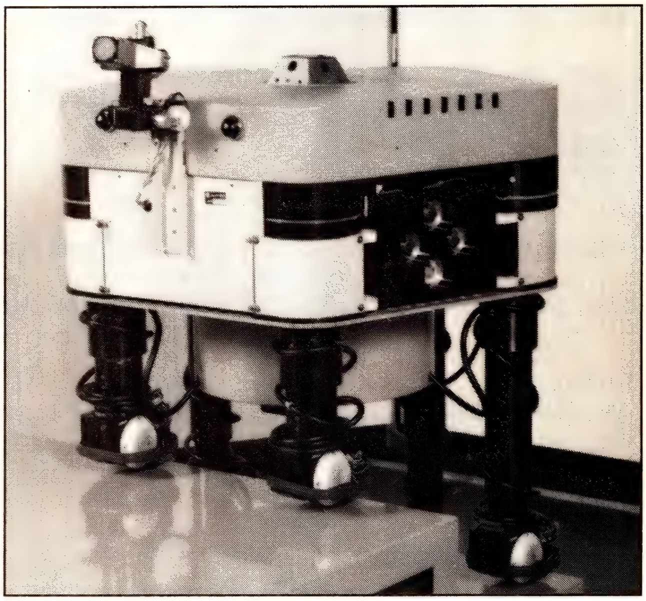
The robot steers itself in a way that minimizes the difference between the predicted map and the actual map, all the while navigating to avoid impassable obstacles. It can open doors, however, as well as manipulate electrical switches, actuate valves, and perform other tasks.

While in operation, the robot recomputes its position and course once each second. Remote control from a base station is taken care of by a radio link that uses spread-spectrum technology to minimize interference by noise. The link also enables the base station to



Up the stairs. Toshiba's Amooty uses four assemblies with three-pronged legs to clamber up and down stairs. Guidance is through microcomputer control paired with a laser/TV optical system.

Map matcher. Hitachi's mobile robot sees its surroundings and stores the features in its memory. It then compares that map with another that carries its route, so it can navigate around obstacles.



view the scene picked up by the robot's vision system. The data-transmission rate is 135 kb/s.

Toshiba is developing its intelligent robot for industry through a joint project with a team headed by Hiroyuki Yoshikawa of the Department of Precision Machinery Engineering at Tokyo University. The work was done under a contract with the Mechanical Social System Foundation, established by the Ministry of International Trade and Industry.

Lock and climb. The team puckishly calls its creation Amooty, an acronym formed from the initial letters of the last names of the six Tokyo University researchers on the project. Amooty moves about on four assemblies of three-spoke legs, each terminated by a wheel (see photo, upper left). On smooth surfaces, two wheels of each leg make contact with the surface and are powered to provide propulsion. To climb staircases, the wheels are locked and the legs rotated.

Amooty's manipulator arm features the six degrees of movement of a human arm and adds another three, equivalent to those in the shoulder and waist. Powered through an umbilical cord, the robot weighs in at 360 kg; its arm can handle loads weighing up to 10 kg.

Amooty scoots about under microcomputer control, programmed in a robot language called Amorl. Two modes are provided. In the first, for travel down a hall, two parallel laser beams are directed against a wall. Distances between the spots where the beams strike the wall are independent of distance between robot and wall. But the separation between spots in the image picked up by a TV camera decreases with increasing distance from wall. In the second mode, the TV camera recognizes targets along the route, akin to a woodsman following a blazed trail.

Bach to Beatles. Although it may never catch on with manufacturing engineers, Sumitomo Electric's robot sounds like a lot more fun. Developed jointly with four professors at Waseda University, in Tokyo, this android can use the fingers of both hands to bang away at a standard organ keyboard up to 15 times a second while treading the pedals with both its feet (they have no toes, but who plays the organ barefoot?).

The robot—weighing 90 kg and standing 180 cm tall—has enough computer power to play selections from memory when told to do so, but it can also read sheet music. Along with hearing, seeing, and doing, this robot can speak. To approximate human articulation, the robot has 50 joints.

To control it, Sumitomo uses 17 16-bit microprocessors and 50 8-bit controllers. The Waseda researchers used Zilog-type Z8000 16-bit processors for the prototype. But Yutaka Wada, senior engineer in the Basic High Technology R&D Department, says Sumitomo engineers are more familiar with Intel types, and converted to them as much as possible in the robot for Science Expo. Where top speed was needed they used 80286s; otherwise, they used 8086s.

Fifteen of the 16-bit processors are located in a control room about 20 m from the robot, while two processors and all the controllers for the servos that operate the joints are in a control box near the robot. Thirteen 32-Mb/s optical data links tie the control box to the control room. ☐

TO OUR READERS: *Our next issue will be a double issue dated Feb. 4. There will be no Jan. 28 issue.*

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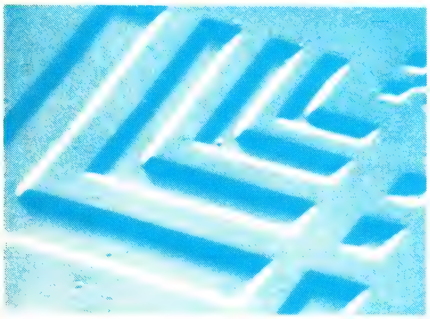

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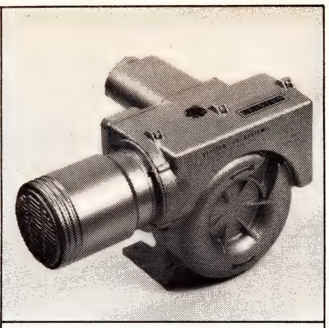

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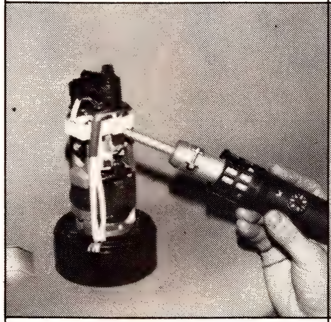

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PLUGGING INTO THE FUTURE

The heavyweight consumer houses are betting that the public is finally ready for computerized home management ☐ *by Wesley R. Iversen*

Las Vegas

The idea of running a home by remote control using modern electronic wizardry has been a gleam in the eye of consumer engineers and electronics entrepreneurs for almost as long as the microprocessor has been around. Unfortunately, their enthusiasm hasn't been shared by the consumers who must foot the bill.

Now, however, there are signs that the home automation/management business may be revving for a takeoff, and some heavyweight competitors are getting into the market.

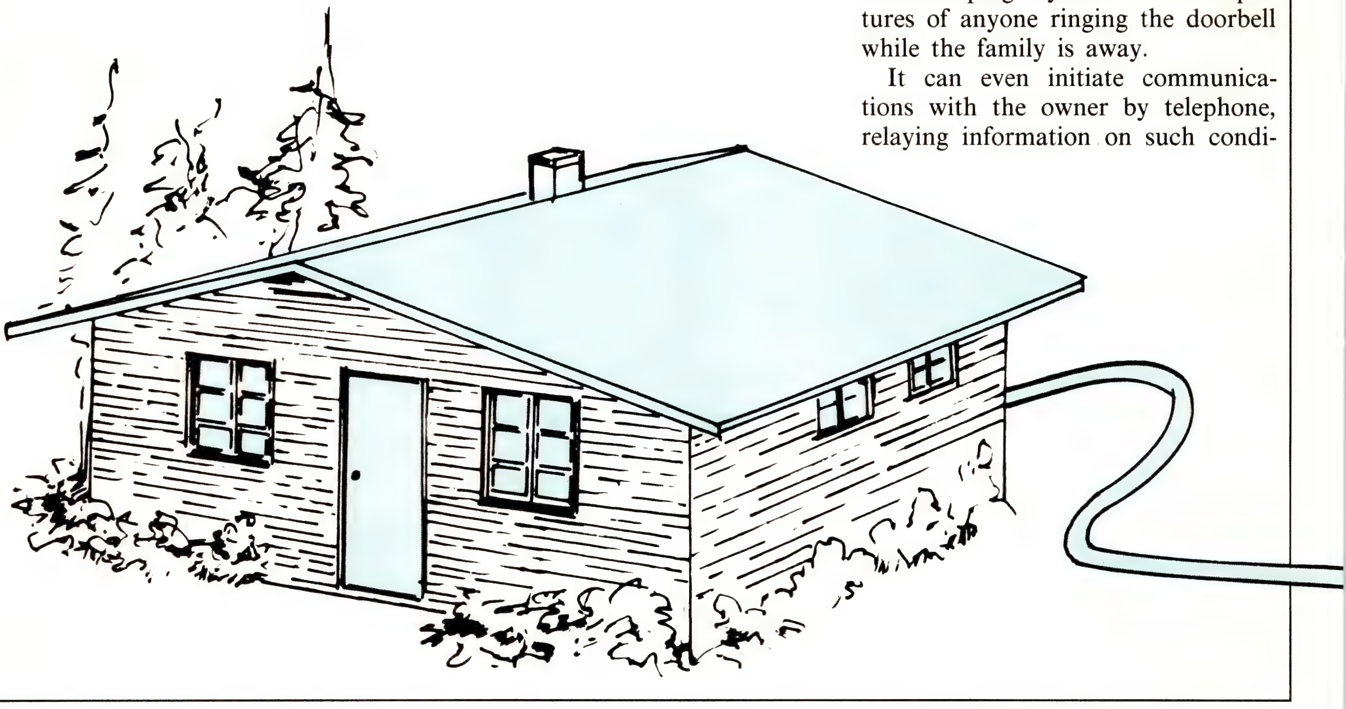
Though specific market projections are hard to come by and the lower-priced systems now on the market have so far met with less than dazzling success, the lure of the home management market for major manufacturers is potent: every house and apartment is a possible candidate for the equipment. "We see this as niche market right now, but we've got figures that show that by 1990, you'll see some sort of home control or electronic security system in 50% of all homes," says a General Electric spokesman.

Two for the show. The latest indicators that the market is heating up came at the recent Winter Consumer Electronics Show held here, where industrial powerhouses Mitsubishi Electric Corp. and General Electric Co. displayed their entries in the home management sweepstakes.

Mitsubishi put together an exhibit using current and promised future products that it calls the Mitsubishi Housekeeping System. The Tokyo firm uses a proprietary bus to link a multiplicity of sensors, appliances, phone, alarm, temperature control, and entertainment systems under distributed, programmable microprocessor control.

Its system can do everything from turning lights on and off automatically and controlling the temperature to opening the doors and windows, sounding an alarm, and calling the authorities if a fire occurs. A homeowner can program Mitsubishi's Housekeeping System to take pictures of anyone ringing the doorbell while the family is away.

It can even initiate communications with the owner by telephone, relaying information on such condi-



tions as an open window to an emergency such as a break-in or a water or gas leak. Unlike some other systems already on the market, it can also be reprogrammed remotely by the owner using any tone-key phone.

Competition waiting. Though Mitsubishi's entrance into the home management business took some corporate courage, the firm has for some time been fine-tuning its system with a more elaborate version already marketed in Japan. When the full system is available in the U.S. some 18 to 24 months from now, it will not be without competition. The General Electric Co., Fairfield, Conn., also used the Las Vegas Show to display a system it unveiled last fall, called the HomeMinder [*ElectronicsWeek*, Sept. 3, 1984, p. 32]. GE leapfrogged into the market by using private-label components supplied by X-10 (U.S.A.) Inc., a Northvale, N.J., company that has marketed its own X-10 home control system since 1979.

Unlike the hard-wired Mitsubishi installation, the X-10/HomeMinder system uses a dwelling's existing power lines for distributing control to lights, appliances, and heating and cooling systems. But GE has added easy-to-use graphics software that allows central control of the system through a TV set using a handheld remote unit similar to an ordinary TV remote controller.

Though less sophisticated than the system planned by Mitsubishi, the HomeMinder is also less expensive. An average system using the standalone HomeMinder unit with 10 to 12 modules that can be plugged into any standard ac socket for connecting lights, appliances, and other equipment retails for about $450, says a GE spokesman.

In contrast, Mitsubishi expects its basic installation, including a wall-mounted master controller with monitor, programming device, and a couple of discrete control units for other rooms in the house, to sell in the $1,000 to $2,000 range, according to Laszlo Z. Kovacs, director of marketing and sales for Medama Inc., a newly formed Mitsubishi division.

These two giants are seemingly fighting for the embrace of a reluctant suitor. In recent years, several firms have entered the business and dropped out. Veteran X-10, which has been selling its system using a hand-held, 16-button central-control module for five years at a typical price of about $200 or less, still claims that it has only about 1 million systems in the field.

Besides its own sales efforts, X-10 also supplies the system on a private-label basis to Sears, Roebuck & Co. and to Radio Shack, both of which market it through their own outlets. X-10 recently introduced a software package priced at $99.95 that enables a Radio Shack Color Computer to be used as the central controller. The firm plans to offer similar packages for the IBM PCjr, Apple IIc, and Commodore 64 by about mid-year.

Problems. Two of the biggest problems the industry faces is the lack of consensus on transmission methods—hard-wired or ac-line—and the lack of interface standards. A consumer who is interested in tying together the various electronic elements of the family home faces the possibility of investing in some expensive hardware—only to find that it is impossible to add or change components in the future.

Not surprisingly, each manufacturer has its own prejudices. X-10 president Peter A. Lesser is skeptical that a system such as Mitsubishi's—which requires a home to be hard-wired with the system bus—can compete against power-line-based systems such as the X-10. "The biggest single advantage of the power-line approach is that it already exists in every home," says Lesser. "The concept of tearing up a house to put in a wired bus is not going to be very appealing to too many people."

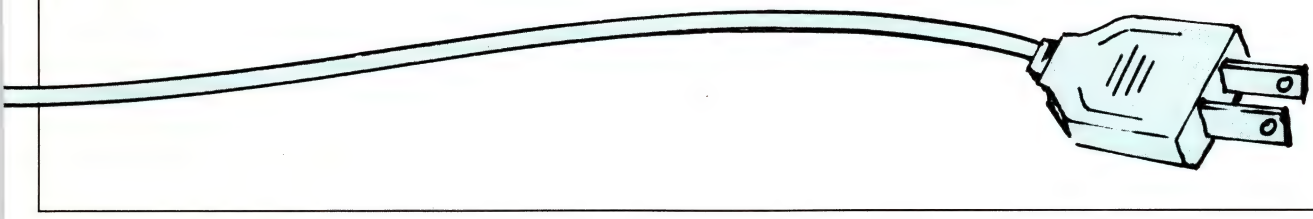
Mitsubishi's Kovacs, however, responds that a hard-wired approach can offer wider bandwidth capabilities for integrating data, video, and audio signals into a system. Furthermore, it will also not be subject to disruptive power-line spikes and interference from neighboring systems.

"To really get a quality system and do it reliably over a long period of time, you pretty much have to go the hard-wired route," he contends. Though Mitsubishi does plan to market its system for installation during new home construction, "we like to think that the retrofit business will be the biggest market."

Tact act. The industry trade group, the Electronic Industries Association's Consumer Electronics Group, in Washington, is hedging its bets—and being politic to the end. Staff engineer Thomas D. Mock expects to see both hard-wired and power-line-based systems in the market. Mock is coordinator for the EIA's Consumer Electronics Bus Committee. Formed in April last year with participation from about 50 companies, the CEBC is working to establish an EIA standard for internal home control and communications and held its most recent monthly meeting here following CES.

The CEBC is divided into three subcommittees—one aimed at power-line systems, a second looking at hard-wired bus approaches (including twisted-pair wires, coaxial cable, and fiber optics), and a third tackling standards for wireless controls used within a single room of a home. The committee expects to complete preliminary specifications for a power-line standard during the first quarter of this year and for wired home bus systems before year-end, says Mock.

Once standards are established, Mock points out, consumers will have more assurance that they can later expand individual components or home management systems, using equipment from a variety of manufacturers. The EIA engineer adds that nearly all major electronic manufacturers are involved to varying degrees in work on home management systems and components, though many have not yet made commitments to a particular approach. ☐



CELLULAR RADIO

TERRAIN DATA BASE SEES BOTH FOREST AND LEAVES

Richardson, Texas

A stickler for detail, Compucon Inc. is paying close attention—right down to the leaves on the trees—when it comes to computer simulation of signal coverage from planned cell sites in cellular-radio phone systems. Not only does Compucon program the type of foliage into its digitized-terrain data bases but its radio-frequency propagation programs can even simulate the effect of water on those leaves.

Placing that much detail into a terrain data base may be a meticulous task, but it has paid off in getting the most out of a cellular broadcast site, says Scott Goldman, director of business development for communications services at Compucon. The engineering consulting firm, which was founded in 1968 and is now a wholly owned subsidiary of A.C. Nielsen Co., has digitized ground elevations in hundreds of U.S. cities since 1980.

Compucon has done most of this work with the use of thousands of U.S. Geological Survey 7.5° topographical maps. (Depending upon latitude, each map represents an area of about four by six miles.) Using infrared and aerial photographs, additional details are added to show the types and heights of buildings, vegetation, and other rf-attenuating objects.

Lean machines. By optimizing each cell and tightly coordinating coverage between sites in a cellular network, operating firms can often minimize the amount of transmission equipment needed without experiencing performance loss, adds Goldman. Some of Compucon's clients—which most often are cellular-system operating firms—have had computers analyze a competitor's coverage to expose pockets of weak signals and missed markets.

In addition to its terrain analysis, Compucon also programs market research data into its analysis, projecting the growth and types of potential subscribers in each cell. Together, the data bases—running on four Digital Equipment Corp. VAX-11/780 minicomputers with 5.7 gigabytes of on-line storage—are used to design and tailor cellular-system coverage for each market.

"A client was planning to put 11 or 12 cells in a market area. We did our propagation analysis based on digitized terrain and backed it up with field measurements from our mobile van," says Goldman. "The work showed two cells were unnecessary because of the propagation characteristics of the terrain. Counting the cell-site equipment and associated peripherals, we saved them nearly three quarters of a million dollars."

Once Compucon creates a detailed terrain data base, possible sites for transmission antennas are entered into the analysis system. Rf-simulation modules calculate signal propagation and attenuation effects of such factors as day, night, weather conditions, buildings, foliage, and bodies of water. (Temperature inversions over water can often cause rf signals to travel farther than they would over land.) Types of building material can also be entered into the system to determine if cellular links can reach into offices and factories.

Signal damped. Compucon's foliage-attenuation models represent six different categories of trees. "In general, there is some additional attenuation associated with wet leaves, but it is not as significant as whether or not trees are pines or deciduous," notes Dan Yost, executive vice president of engineering. "When the leaves come on trees, the land mobile signals—especially at 900 MHz—can become scattered, resulting in a loss in the wooded areas."

After propagation and attenuation modules are simulated for an antenna site, data can be displayed in a number of ways, including color plots of rf-signal strength in a radius around the transmitter. Terrain displays also may be automatically viewed in three-dimensional images, which can be rotated on the screen to give system designers different views of potential trouble spots, says Goldman. **–J. Robert Lineback**

Mapping trouble spots. Compucon's Scott Goldman points to detailed printouts of terrain maps and cellular-radio coverage. By optimizing each cell and coordinating coverage between sites in a cellular network, firms can reduce the amount of transmission equipment.

LINEAR LED ARRAY HAS 300 PIXEL/IN. RESOLUTION

Heilbronn, West Germany

With five years of experience in making linear light-emitting-diode arrays that meet the exacting demands of military applications, Telefunken electronic GmbH has the fabrication technology well in hand. Thus the firm is confident about branching into commercial production of medium-cost—yet high-precision—versions for use as print heads in nonimpact printers.

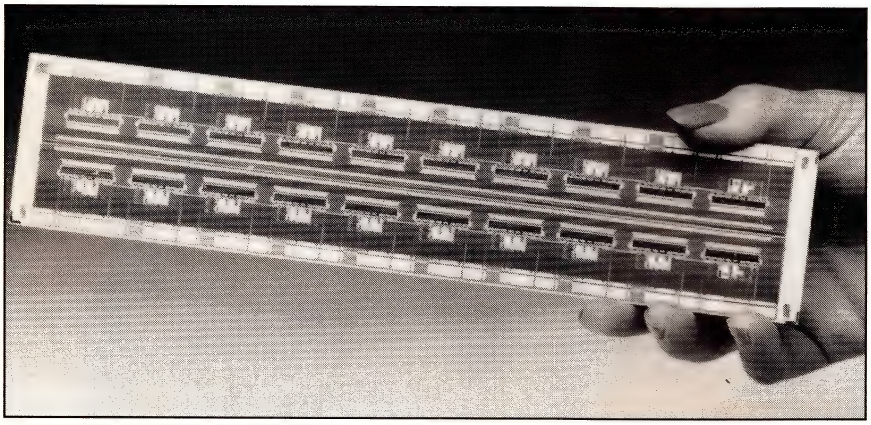
Production of the LEDA, for LED array, will start during the first quarter of 1985 in this Swabian town. Samples are already being delivered to selected customers. In large volumes, the LEDA will probably sell for under $400.

LED writer. In a nonimpact printer, a linear LEDA functions much like an addressable light source, explains Elmar Wagner, head of optoelectronic device development at Telefunken. The individual LEDs are switched on and off in accordance with a bit pattern (that can come from, for example, a data-processing system) representing the information to be printed.

The light from the LEDs hits the photosensitive layer on a drum. This produces a charge image that, with the help of a toner, is transferred onto paper as a black and white picture or a page of text.

The photosensitive layer can also be exposed using a semiconductor laser whose beam is made to scan the drum in an axial direction through rotating mirrors or a holographic deflector, Wagner says. But such mechanical movement, which must be synchronized with the movement of the drum and paper, complicates printer design and makes the equipment less reliable.

But this is not the case with a linear LEDA. Because the array is stationary, covering the drum's whole width, no mechanical movement is involved—so there is no need for axial synchronization. Besides the absence of movement, an LED's shorter wavelength should also appeal to printer manufacturers: for a red LED, the peak wavelength is typically 660 nm, compared with 780 to 800 nm for a semiconductor laser. The shorter wavelengths eliminate the need for a special drum with enhanced infrared sensitivity.


LED head. The LEDA print head has a row of 2,560 red LEDs along the center line of this 24-by-6-cm hybrid circuit. Driving them are 20 integrated-injection-logic ICs on either side of the row.

With its LEDA, Telefunken is the first LED print-head producer in the western hemisphere. One Japanese firm, Sanyo Electric Co., has announced a nonimpact printer that uses a similar LED array [*Electronics,* April 5, 1984, p. 76].

The LEDA is a 24-by-6-cm hybrid circuit (see photo) with 2,560 red LEDs arranged in one row and 20 integrated circuits—all mounted on a ceramic substrate. The ICs, which are based on integrated-injection-logic technology to achieve monolithic integration of digital and analog functions, drive the gallium arsenide phosphide LEDs. Each LED measures 40 by 65 μm.

For better yield in fabrication, the array is made of several joined sections, each with 128 LEDs and the associated ICs. The LEDs have a pitch of 85 μm, which means that the array has a resolution of 300 pixels/in., or 12 pixels/mm. This resolution is more than enough to print out high-quality text and graphics. In another LEDA version, one for offset-printing applications, the LED pitch is 62.5 μm, which translates into a resolution of 400 pixels/in., or 16 pixels/mm.

Accurate pitch. There are no visible gaps between the adjacent array sections. The guaranteed accuracy of the pitch at the joint between two sections is 20 μm. The typical pitch, however, is far more accurate—only 6 to 8 μm, Wagner says.

In LEDA operation, the bit pattern of the image to be printed is fed as an 8-bit parallel data stream into the IC's shift registers with a 500-kHz maximum clock frequency, which corresponds to a 4-Mb/s data rate. A strobe signal initiates the transfer of the bit pattern from the shift registers to data buffers. Another signal activates the LED switching process.

According to the information in the data buffers, a current whose magnitude is given by the current control setting flows through the LEDs. The current through the LEDs is either kept constant up to the next strobe signal, or the LEDs may be switched on or off by the current control input. Flexible cables connect the LEDA print head to the external printer circuitry.

The typical operating current for the LEDs is 3 mA. At this value, each LED delivers approximately 10 μW, which corresponds to a luminous flux of roughly 0.5 millilumens. The LED radiant efficiency is typically 1.8 μW/mA. Tests conducted by the company have shown that operation of more than 10,000 hours can be expected. **–John Gosch**

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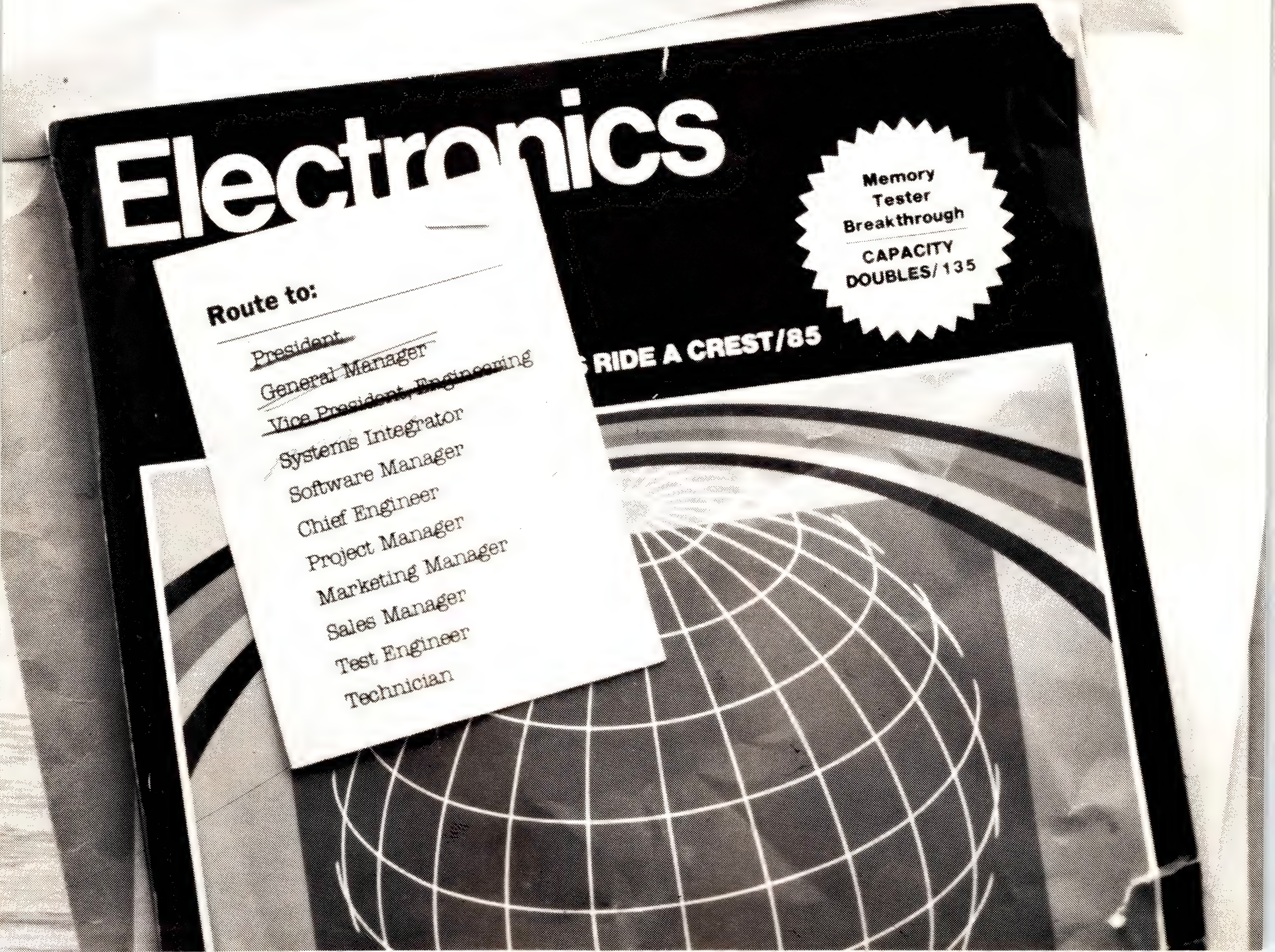
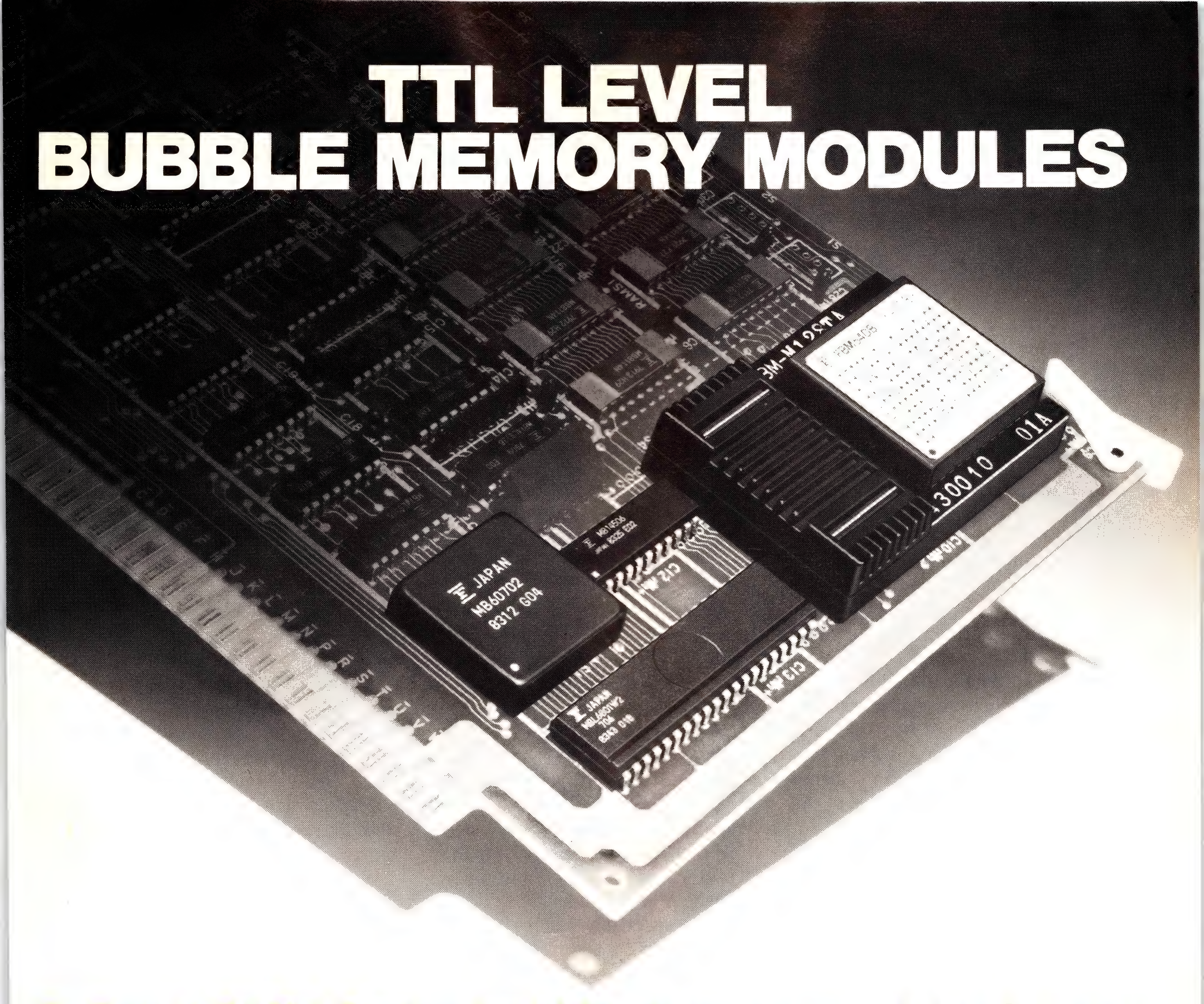


TTL LEVEL
BUBBLE MEMORY MODULES



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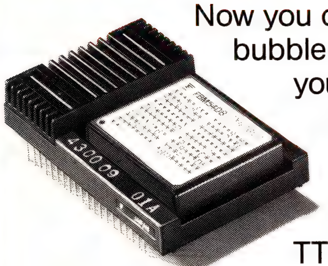

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Interface	TTL level	
Transfer rate	100K bit/s	
Access time	11.2ms	
Operating temp.	0 to 65°C	5 to 50°C
Storage temp.	–40 to 85°C	–30 to 75°C
Weight	75g	
Dimensions	43.5 x 65.5 x 13.7mm	

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FCC MAY JAM SPREAD SPECTRUM

Washington

Encouraged thus far by Federal Communications Commission policies to speed up commercialization of spread-spectrum modulation, entrepreneurs are finding increasingly innovative ways to deploy the technology. The latest idea comes from Applied Spectrum Technologies Inc., a Minneapolis group of engineers who want to route spread-spectrum signals over public switched networks to security-alarm agencies.

Digital dialer systems, in which a telephone automatically calls a security service when an alarm goes off, also use the public network. But Barrs Lewis, the startup's vice-president of sales and marketing, claims that spread-spectrum technology affords more security.

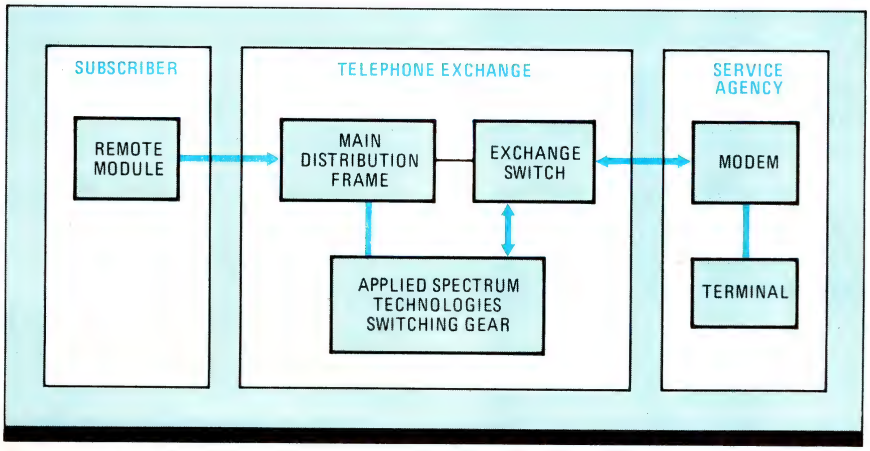
He says that once a line goes down with a digital dialer system, there is no way to send a message. However, with spread-spectrum technology and his firm's equipment, the phone company polls the signal for change every four seconds. This way, if someone cuts the line, a change is registered, and a message goes to the alarm service. The frequency hopping used in spread-spectrum technology also thwarts attempted jams and taps of the signal, he says.

Before Applied Spectrum Technologies can offer its service over phone company lines, however, it must get an FCC determination that spread-spectrum technology is a "basic" offering in accordance with its Computer II ruling, which restricts Bell operating companies (BOCs) from using their central transmission facilities for anything other than plain-jane phone service. Without this basic determination or a waiver of the Computer II rules, the firm stands "virtually paralyzed, with no opportunity to introduce [its] innovation to the marketplace," as it pleads in its pending appeal before the FCC.

Public switching. Why is working with the BOCs indispensable to the firm's future? The link with phone-company lines makes the service more cost-effective than private lines, says Lewis, who details how the system would work with the BOCs.

Spread-spectrum technology lets the firm offer "the simultaneous and independent transmission of data over voice information without causing interference to either," says Lewis. The frequency-hopping technique takes an initial signal 15 Hz wide and spreads it in a pseudorandom manner over the entire 3,000-Hz voice bandwidth. Because the signal dwells on a given frequency for only one quarter of a cycle before hopping to the next one, it doesn't interfere with the voice signal, notes Lewis. To make a total white-noise effect, the company then uses a smoothing algorithm to suppress any excess energy below the background noise level.

At that point, Applied Spectrum Technology has a modulated spread-spectrum signal ready to be routed from the customer's location to the alarm agency by the telephone company. Yet without the firm's special equipment, insufficient fidelity would cause the signal to disintegrate at the central office switch. This is because the switch can't take enough samples per second to capture the modulation, Lewis explains. The company's equipment demodulates the signal and converts it to a conventional ASCII format.



Spreading it out. Applied Spectrum Technology's switching gear prevents disintegration of its spread-spectrum signal at the central office switch by demodulating and converting it to ASCII. The converted signal then is routed over the public network to the security alarm agency.

Advantages. Use of the public network gives the firm a unique advantage. "Unlike other competitive security services that rely on costly private line connections, low-speed spread-spectrum signals superimposed on the local loop and switched by central offices can be provided for as little as $7 to $10 per month with equal or superior quality," it claims in its petition. By contrast, the cost of leasing a dedicated line ranges from $16 to $70 a month, depending on state tariff structures.

For the FCC, however, the first issue is not the novel use of spread-spectrum technology, but whether the approach is in violation of Computer II rules. Already, Kurt DeSoto, the agency attorney handling the case, sees problems. "That BOCs would be scanning the signal in addition to changing it into ASCII code constitutes enhanced and not basic offerings by our definition," he says. The firm counters that its service is basic because "information content going into the system remains the same at the end."

If the FCC rules that the service is not basic, the firm would need a waiver to proceed. But it is confident of a positive result from the FCC and has started to market its spread-spectrum gear among security-alarm services. The BOCs, Lewis says, are interested, but they are reluctant to buy until the FCC makes its determination. –**Karen Berney**

LEDs LIGHT WAY TO FIBER-OPTIC LANs

Los Angeles

Although industry seers widely proclaim that optical fibers will become the prime medium for local-area networks, two missing links for short-range networks must still be forged. Before a mass market can emerge, the industry needs a high-speed transmitter and a receiver—both in modular form and both at an affordable price.

However, 1985 could see their arrival. PlessCor Optronics Inc. has set the pace by replacing the higher-performance but more complex and expensive 1.3-μm injection-laser-diode transmitter commonly used in the many long-range fiber-optic networks now in operation with a simpler light-emitting diode. The firm says that it has already put the first prototypes of the new device into customers' hands.

To further cut down on price, PlessCor designed the LED transmitter and a p-i-n photodiode receiver to operate at the same 1.3-μm-long wavelength in order to take advantage of the low transmission loss and the efficient material properties of silica fibers found at this wavelength. These devices, which are made of indium gallium arsenide phosphide, run at 50 Mb/s.

Faster transmitting and receiving pairs rated at 125 and 200 Mb/s have been demonstrated in the laboratory. Samples are slated to be shipped to customers during the first half of the year.

The new devices have already encountered encouraging response from prospective customers, according to Bor U. Chen, PlessCor vice president. Chen, who guided their development, sees the devices as more than individual products. To him, they represent the first attempt to target what looks to be the definitive mass market for optical-fiber hardware: computer communications and other LAN applications.

Until now, telephony installations with far different requirements have prevailed in such applications, he notes. Among these requirements are higher data rates, now at 400 to 500 Mb/s, that demand more complex components and, consequently, more servicing.

Hold down the heat. Getting rid of the injection laser in favor of an LED, therefore, is a key move, because it eliminates sources of potential trouble in an optical system, Chen explains. For one, the laser needs a thermal electrical cooler to keep the temperature at a constant 20° to 25°C, because reliability decreases if the part gets hot. Excess heat also increases the lasing threshold, making it harder to drive.

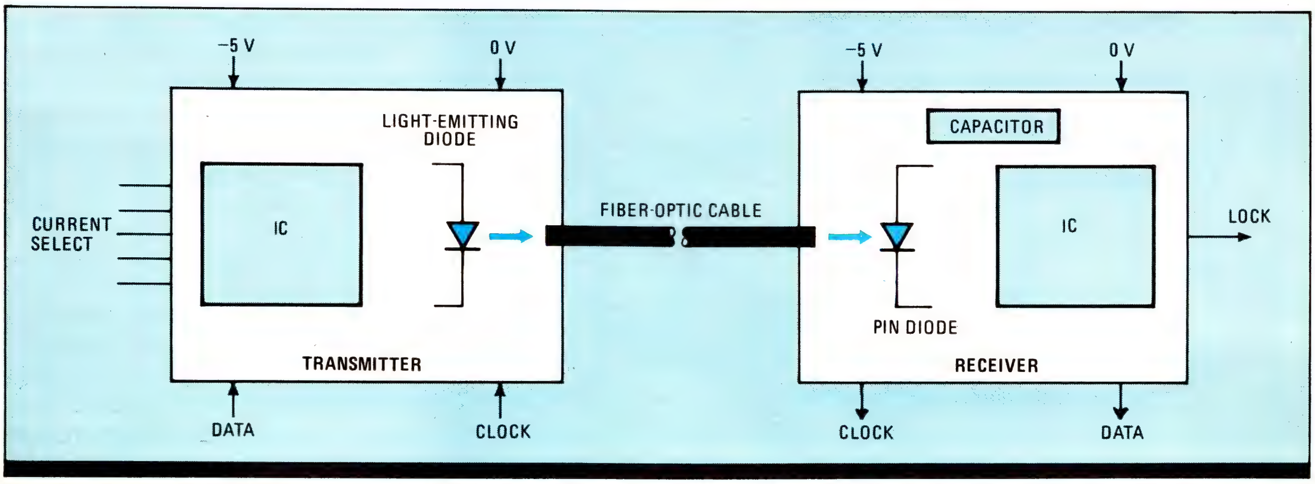
Another drawback is the need to control output power with optical feedback circuits, which LEDs don't need. While LEDs inherently have a lower modulation speed, Chen says that PlessCor made several proprietary improvements to get them up to the top bit rates with little difficulty. In fact, the 1.3-μm LED and p-i-n diode have been demonstrated experimentally in a fiber-optic system at rates as high as 2 Gb/s, according to the PlessCor researcher.

Easy does it. Another feature that should make the new parts attractive to users who want a local fiber-optic network addresses the troublesome task of connecting components to the fibers using discrete parts. Both the transmitter and receiver modules have an integral fiber-optic connector in their packages to make this job easy.

The connection pins are positioned in a manner similar to the standard dual in-line package, with pin spacing of 2.54 mm. Excluding the connector, the size is less than 1 by ½ by ½ in.

All specifications of the PlessCor components have not yet been fully measured but should be ready soon. The price of the transmitter/receiver pair is expected to be several hundred dollars each in volume, but should come down steadily as production grows.

Although PlessCor is a startup, it enjoys the benefit of heavyweight



Making the connection. Transmitters based on light-emitting diodes are relatively inexpensive and require no cooling. Paired with p-i-n diode receivers, they light the way to fiber-optic systems that are suitable for use in high-speed local-area networks.

support from its two chief investors: Corning Glass Works, a U.S. fiber supplier, and The Plessey Co. plc., the British industrial giant [*ElectronicsWeek*, Aug. 6, 1984, p. 63). Plessey designs and fabricates the ICs for PlessCor's products.

Even with its early start and solid support, PlessCor faces fast-moving competition, notably from Hewlett-Packard Co.'s Optical Communication Division, in Palo Alto.

"This is an exciting future market," says Joseph H. Bagley, marketing manager, whose division was formed in HP's Components Group this past November to exploit the market for fiber-optic networks and the optocoupler business. He says PlessCor made the right choice with its LED approach. Though HP policy precludes tipping products in advance, Bagley leaves little doubt that the firm is pushing hard to get its entry in the race.

Other prospective competitors include AT&T Co., which is reported to be close to announcing its own transmitter/receiver pair, and the West German electronics giant Siemens AG. Several Japanese semiconductor houses are also working on similar devices. **–Larry Waller**

MARINE ELECTRONICS

COMPUTERS AT THE HELM

New York

When the skipper of the Australia II sailed home to Perth with the America's Cup, some decried the intrusion of computers into the world of sailboats and seamanship, for the keel that gave Australia its edge was computer designed, and shipboard real-time data acquisition and analysis helped the 12-m boat cross the line first. Computers, in sum, had forever changed the character of big-time sailboat racing.

But digital electronics in boating has done more than benefit yachting's elite. Although hard numbers showing electronic gear's share of the $12 billion pleasure-boating industry are hard to come by, experts agree the figures are big. A rule of thumb is that about 8% of the cost of a boat typically goes for electronics.

Frank Scalpone, executive vice president of the National Marine Manufacturers Association here, estimates that about $250 million annually is spent on electronics hardware. That falls within the range cited by Charles S. Carney, executive director of the National Marine Electronics Association in Oronoco, Minn.

A 30-year industry veteran, Scalpone credits growing user sophistication for the strong upsurge in spending for pleasure-craft electronics. "The average guy is just much more familiar with electronics," he says, and this accounts for the user's willingness to invest in costly gear.

"Eventually, half the boats over 30 ft long will have computer-aided navigation," contends Peter H. Fleiss, president of Atlantic Marine Marketing. The firm, based in Stamford, Conn., has targeted pleasure craft and small commercial fishing boats with a data acquisition and analysis system based around the 8-bit M6809 microprocessor. With wind and water transducers and compass units feeding his boat's central computer, a computer-aided captain can select from more than 20 different performance measurements and navigational aids.

For example, by combining data from wind transducer and compass bearings, "velocity made good"—a boat's true speed—can be calculated, as can the best possible heading to a mark regardless of present heading or position can be calculated. That's a big plus for a racer on a tack.

Casting nets. If microprocessors in growing numbers are coming aboard pleasure boats, then networking schemes are bound to be soon in tow. At Datamarine International Inc., Pocasset, Mass., vice president of engineering Richard Harrison and crew have launched a 4,800-baud collision-sensing multiple-access network with collision detection. It ties together a line of 8051-based data-acquisition devices.

"We use microprocessors even in our less expensive product lines because we can decrease cost, increase functionality, and decrease our parts count," says Harrison. He adds that the distributed network provides more reliability.

But even as they busily build new products, marine electronics designers wonder what an old salt would think of the new high-tech emphasis. Says Harrison, "You'd be amazed about the types of electronics that people want on boats. But if you ask them about functions like velocity made good, they really can't explain just what it is." **–Robert Rosenberg**

Big market. It is difficult to tell exactly how much is spent for electronic equipment in the $12 billion-a-year pleasure-boat industry. But it is estimated that 8% of the cost of a boat, such as those at last week's National Boat Show in New York, goes for electronic gear.

E-SCHOOLS FACE FACULTY CRISIS

Undergraduate courses in manufacturing are on the rise, but professors with industrial experience are hard to come by

☐ *By George Leopold*

New York

While intense international competition and a need for increased productivity have fueled widespread interest in application-oriented manufacturing programs, experts say that a critical situation exists at many of the nation's engineering schools. Officials of professional engineering societies, engineering schools, the federal government, and industry all point to an inability to find qualified faculty with industrial experience.

> **“We are in a crisis situation, not of our own doing. . .**

Programs plannned. To meet the growing student demand, about 60 engineering schools have established or plan to start manufacturing programs, according to an informal survey conducted by the National Science Foundation in Washington. "Quite a number of these are having difficulty finding qualified faculty," notes William Spurgeon, director of the NSF's Production Research Program.

And many experts see no speedy solution. Another Washington official, David R. Reyes-Guerra, executive director of the Accreditation Board for Engineering and Technology, predicts that it will take from 5 to 10 years to attract qualified faculty who can adequately convey manufacturing concepts in the classroom.

"We are in a crisis situation, a crisis not of our own doing," says Reyes-Guerra, who characterizes the situation as "an instance where the brain-drain went the other way and has come back to haunt us."

"Where [qualified teachers] are going to come from, I don't know," concurs Otis J. Sproul, dean of the College of Engineering and Physical Sciences at the University of New Hampshire in Durham. Although Sproul says that he has attempted to attract better-qualified faculty by offering higher salaries, he sees them going instead in increasing numbers to the more prestigious and better-endowed schools.

Despite grant programs by schools and industry, Eugene Minton of the Society of Manufacturing Engineers says, "We just are not able to return [engineering graduates] to the academic mainstream." Moreover, Minton explains that graduates willing to make the financial sacrifices necessary to remain in academia tend to be research-oriented rather than application-oriented. This further exacerbates the problem of meeting increased demand for manufacturing courses.

The traditional answer to this problem has been to offer competitive salaries to attract engineering professionals as full-time, tenured faculty. Donald Weinart, executive director of the National Society of Professional Engineers, Alexandria, Va., offers two other solutions: either hire engineering professionals as adjunct faculty, or institute exchange programs whereby faculty members gain industry experience during summer months and professionals share their experience in the classroom.

Potential is there. "I think we've got the capability to get that kind of expertise in the classroom," says Weinart, whose organization lobbies on behalf of the engineering profession. "We just have to be aggressive about it." National Science Foundation programs in engineering will be closely watched by the society, he says, but "it's going to be a tough budget year for everybody."

> **. . . the brain-drain went the other way and has come back to haunt us.”**

Many corporations, such as IBM

Corp., have worked with schools to promote manufacturing curriculum. In 1982, IBM's manufacturing research program awarded five $2 million grants to be spread over a five-year period. The purpose of the grants was to help graduate engineering schools improve manufacturing systems education through curriculum development and research into integrated manufacturing, according to Louis Robinson, IBM's director of university relations.

One recipient, Rensselaer Polytechnic Institute, Troy, N.Y., is using its IBM grant to help develop a Center for Manufacturing Productivity it established in 1979. With a total of 16 corporate sponsors, the center has obtained over $2 million in contract work for the 1984-85 academic year. "The center was founded basically in recognition of a national need," explains Paul DeRusso, acting dean of RPI's School of Engineering.

"Registration for the program is going right through the roof," adds Leo Hanifin, the center's director. Enrollment for a three-course sequence in advanced manufacturing has ballooned from 25 students in 1981-82 to 236 last year. The master's program in manufacturing systems is likely to triple in enrollment, Hanifin reports.

One reason for the program's popularity is the presence of eight project managers drawn from industry. "In essence, we are rotating engineers from industry to education and back to industry," says DeRusso. The managers stay a maximum of five years. Notes Hanifin, "They get a salary that's competitive with industry and that's a real key."

Hot prospects. Carnegie-Mellon University, Pittsburgh, has also been successful in meshing its manufacturing curriculum with industry needs. The university's Fabrics II Program, which is intended to create a design automation system for very large-scale integrated circuits, is also geared to improving VLSI yields. Seven graduate students participate in the program and, according to Andrzej J. Strojwas, an assistant professor in Carnegie-Mellon's Department of Electrical and Computer Engineering, they "are becoming hot prospects to IC makers."

As the corporate role in education and research grows, critics have raised questions about possible threats to academic freedom posed by the relationship. Richard Kenyon, dean of the College of Engineering at Rochester Institute of Technology, Rochester, N.Y., acknowledges, as do other university officials, that the university-industry relationship is in fact *quid pro quo.*

"I don't know that it's a problem, but it is a concern," he says. "We need to maintain our independence as an academic institution." Nevertheless, he sees the formation of a consortium of universities and companies as industry narrows the focus of future research grants toward applications.

> **"Registration for the program is going right through the roof."**

IC fabrication. Rochester's microelectronic engineering program has 10 industrial affiliates, including Digital Equipment Corp.'s Large Scale Integration Group, Hudson, Mass. DEC is providing $470,000 in grants and semiconductor equipment to the five-year undergraduate program launched in September 1982 to train engineering students in the fabrication of ICs.

Rochester says its microelectronics program has a current enrollment of approximately 200 and is expected to reach 300 by 1987. Kenyon attributes the dramatic surge of interest in manufacturing engineering in part to a slowdown in the growth of computer sciences. "We're typical of what's happening in institutions across the state," adds Kenyon, who is also a member of the board of governors of the American Society of Manufacturing Engineers.

In a 1982 position paper titled "Engineering Education in the U.S.," the Institute of Electrical and Electronics Engineers concluded that engineering enrollment had roughly doubled in the preceding decade. Student-faculty ratios were on the rise and approximately 2,000 faculty vacancies existed. According to Edward W. Ernst, acting chairman of the Electrical and Computing Engineering Department at the University of Illinois and former IEEE vice president for educational affairs, the vacancy figure remains about the same today.

With student-faculty ratios of 30:1 not uncommon now, Ernst recommends ratios ranging from approximately 8:1 or less for research-oriented programs to 16:1 for undergraduate courses. More importantly, he says graduate-student-to-faculty ratios should not exceed 5:1.

Citing industry-sponsored research programs administered by the American Society of Engineering Education, Ernst says some headway is being made to alleviate the faculty problem. Last September, the ASEE completed a two-year Engineering College Faculty Shortage Program funded by 10 major corporations. According to W. Edward Lear, ASEE executive director, the survey confirmed the existence of severe shortages of budgeted faculty positions and recommended attracting more U.S. citizens to graduate engineering programs.

Central issue. Lear says a two-year Quality of Engineering Education Program with 30 industrial sponsors has been initiated to examine four areas: the nature of preparations for the teaching of engineering, an area being investigated for the first time; continuing technical education of faculty; the impact of technology such as computer systems and satellites on engineering education; and the problem of obsolete laboratory facilities at the undergraduate level. Despite specific concerns about more and better manufacturing engineering courses and attracting qualified faculty, Lear emphasizes that the central issue underlying both programs is maintaining the quality of engineering education. □

AT&T CAMPAIGNS FOR ISDN NORM

Palo Alto

AT&T Technologies has enlisted some powerful new allies in the semiconductor industry in support of its bid to establish a standard for voice and data communications. While producers of private branch exchanges fight to keep options open in the slow development of the integrated services digital network standard, three U.S. chip firms have offered strong support for AT&T's proposed 64-kb/s interface.

ISDN, a standard looking for hardware, will provide end-to-end digital channels under a user's control and a wider range of services across the network using interleaved bit streams. It will also provide a set of standard interfaces to link all sorts of terminals—gear and facsimile for voice and data, for example—to the switched telephone system. The interfaces now available are proprietary to the host systems.

Last November, however, the International Telegraph and Telephone Consultative Committee approved a 4-wire ISDN protocol that meshed well with AT&T's Digital Multiplex Interface (DMI), which is an ISDN computer-to-PBX precursor.

Chip makers sign on. This month, AT&T submitted the CCITT specification to an American National Standards Institute affiliate, the T1D1 committee of the Exchange Carrier Standards Association. Silicon Valley chip houses Intel Corp. and Advanced Micro Devices Inc. and the Semiconductor Products Division of Rockwell International, Newport Beach, Calif., immediately said that they would produce circuits implementing the standard. Three Japanese houses are also reported to have chips in the works.

Hewlett-Packard Co. and Wang Laboratories Inc. also promised products supporting DMI. HP will show an interface on its 3000 series computer at Interface '85 in Atlanta in March. But Wang stated clearly, and HP hinted, that the issue is far from being settled.

In contention. Another protocol, the Computer-PBX Interface (CPI) developed by Northern Telecom Inc. and Digital Equipment Corp., provides twenty-four 56-kb/s data channels where DMI has twenty-three 64-kb/s data channels and a single common signaling channel. Out of this discrepancy has arisen a familiar struggle—with advocates of a new industry standard competing against those manufacturers having a large installed base.

In addition to DEC and Northern Telecom, Prime Computer, American Telecom, InteCom, Mitel, and Rolm are lining up behind the CPI interface. Both Data General and Wang straddle the fence; support for the new DMI protocol comes from Honeywell, HP, and AT&T. At Wang, voice and data systems specialist Bud Benton says that he wishes there were only one interface for ISDN. But he is resigned to building two—at least for now.

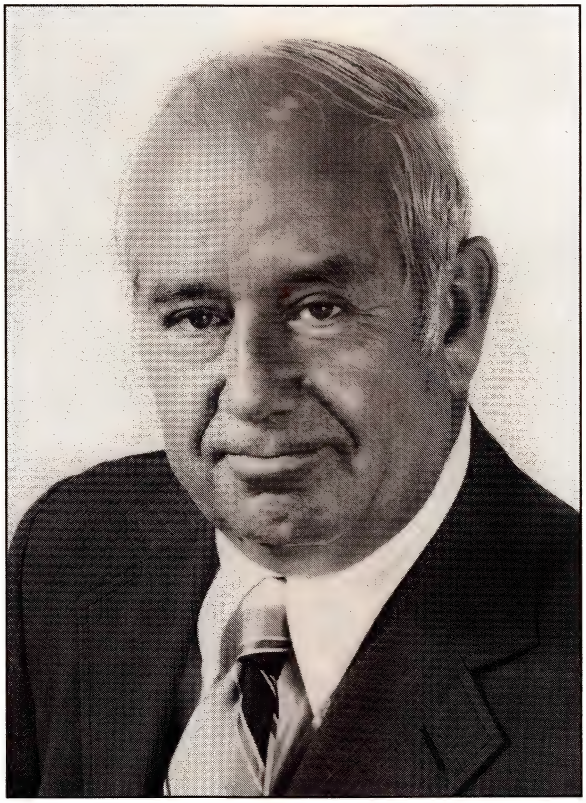
The standards issue arises at a time when the semiconductor industry is looking for its next growth in communications circuits. To Ronald R. Ruebusch, communications products manager at AMD, the AT&T specification is a chance to open up a new market.

AMD will introduce two CMOS chips, a digital phone card and a digital line card, and two bipolar controllers sometime this year. "We see this as a major potential market," Ruebusch says. "It's where telecommunications and computers come together." The chip companies would make the interface cost-effective, Ruebusch adds, so that PBX voice and data systems could coexist with faster but more expensive local-area networks.

Intel, meanwhile, has already begun shipping samples of a CMOS combination codec and filter and a line-controller. An ISDN transceiver will be available in the fourth quarter of 1985, according to Intel product manager Fred Cherrick.

"We have found manufacturers of terminal equipment reluctant to develop ISDN interfaces," he says. "This agreement helps remove a stumbling block." But Cherrick adds that Intel would also have a chip supporting the CPI protocol.

Soon after his five new allies in the semiconductor field signed on, AT&T Technologies chairman James E. Olson issued a cautiously worded statement welcoming their support in making an ISDN standard. But the telecommunications company did not announce any ISDN products itself. **–Clifford Barney**



Well backed. Headed by James Olson, AT&T Technologies has won support from three heavyweight chip makers and two computer firms for its 64-kb/s ISDN interface.

COMPUTER CRIME PROBLEM GROWS

Ingenious and often undetected, computer criminals spur a rapid rise in the market for new preventive measures

☐ *by Merja Lehtinen*

New York

It's 10 o'clock on a Tuesday morning in Manhattan. Trading is heavy at a securities brokerage firm, with phone lines clattering and brokers putting clients on hold as buy and sell orders are placed. No one notices when $400,000 worth of stock moves from one customer's account to another.

Moments later, the stock is transferred again, ending up in a number of savings accounts in several Midwestern banks. The thief stands, stretches, wanders into his kitchen, and looks out his window to the Maine coastline. Not a bad take for 20 minutes' work. He pours a cup of coffee and goes back to writing his book, his full-time occupation in the out-of-the-way New England town.

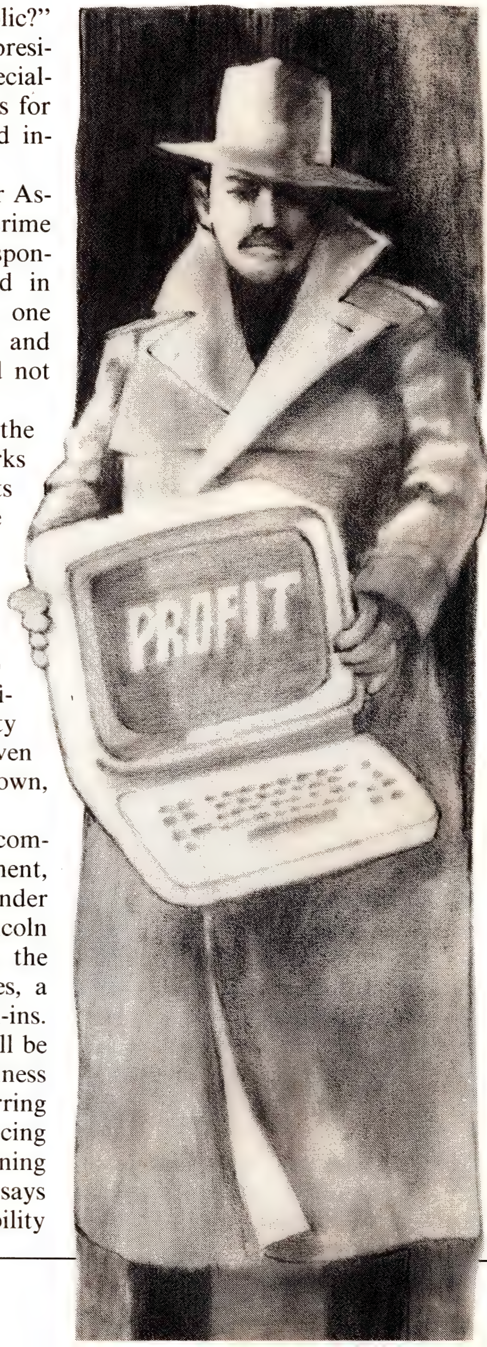
Though this crime never actually occurred, computer-security sources indicate that it could. Specialists in the field say computer crime is a national crisis, it's quiet, and it's happening now. But most people know very little—or nothing—about it. Teenage hackers, those talented and misguided youths who use their home computers to invade government and corporate computer systems, have brought one form of it to light, and they remain the most visible perpetrators of computer-security crime.

But there are also criminals who have not even been identified; their crimes are too costly and too embarrassing to society. "If you were a major bank, would you want to disclose that someone got into your electronic transfer system—much less how—and make that public?" asks Jim Nichols, senior vice president of Futurex Inc., a firm specializing in devising security systems for banks, government agencies, and insurance companies.

A survey by the American Bar Association on computer-aided crime found that about half of the respondents said they were victimized in the past year. Of those victims, one third did not report the crime, and 39% reported the crime but did not identify any suspects.

Recent media attention on the actions of hackers—and networks of hackers—has brought out facts about credit-card theft. But one source says the real damage is in the financial sector, where in the last few years, the industry has lost tens of millions of dollars that it doesn't want to talk about. "The people in the financial field have their credibility at stake," explains Nichols. "Even when they do track someone down, they don't want to prosecute."

NSA acts. In a bid to thwart computer crime against the government, the National Security Agency, under the direction of Lt. Gen. Lincoln Faurer, has begun coordinating the development of secure telephones, a crucial link in computer break-ins. Results from the development will be made available to the U.S. business and industrial community, spurring growth of the market and enhancing security, says the NSA. Explaining the move, an NSA spokesman says that the agency has "responsibility



for all government secure operations, and now has a broader mission for the private sector as well."

The NSA says that the secure phone system it is developing will convert normal speech to digital form, encrypt this by adding a pseudorandom digital stream, and then transmit this encrypted data over the telephone line using an advanced form of digital modulation. At the receiver end, the speech would be decrypted and converted back to normal speech. Fully automatic within a secure phone, the process would be transparent to the user.

Tamper-proof. According to the NSA, the secure phone will have built-in protection against tampering, and the integrated circuitry used would not be susceptible to duplication by visual observation such as a photograph.

NSA sources say the project's specific goal is to reduce the cost of secure telephones to $2,000 or less by 1987. The NSA is selecting project vendors from among AT&T, ITT, GTE, Motorola, and RCA. Two companies will be selected within the next few months to do the actual development work, and these manufacturers will then be authorized to market to the private sector.

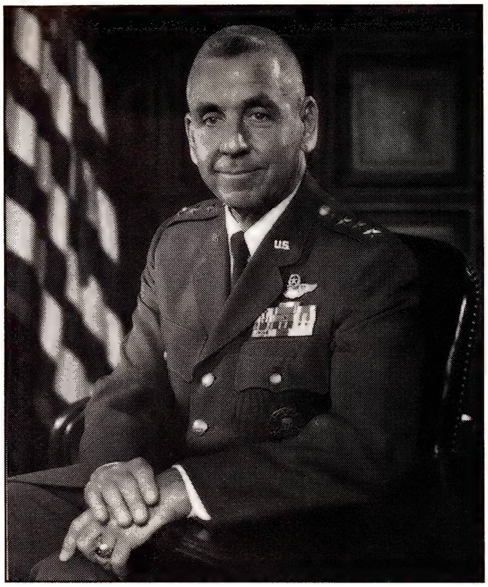
The NSA believes that the potential revenue from the sale of the technology to the private sector is "an inducement to the vendors to invest their own capital in the development, and also allows for amortizing production cost over a larger base."

No one knows the total financial damage being done by computer thieves. Some say the average computer crime totals between $100,000 and $400,000. Others—notably suppliers of security devices—claim thefts have reached as high as $1.5 million. One analyst cites $800,000, attributing this statistic to the Federal Bureau of Investigation.

Interestingly, the FBI maintains no computer-crime data base with any such figures, according to agent Layne Bonner at FBI headquarters in Washington. His best estimate for the average computer crime theft is $400,000. Bonner notes that very few computer crimes are ever reported, so FBI data is limited. According to the ABA survey, known and verifiable computer crime losses ranged anywhere from $2 million to $10 million per year per company.

Whatever the actual cost, all industry sources agree that the stakes are high, with relatively low risk to the potential criminal. The artful hacker is so ingenious that laws have not yet defined the new areas of electronic trespassing. Part of the problem is that there is not even a consensus on a definition of what constitutes computer theft. In fact, some victims will admit they didn't even know they were hit.

Officials who investigate computer crimes are close mouthed for fear that revealing information on thefts will spur more criminals to get into the game. Thus potential solutions to criminal acts are being developed under top security.


NSA takes charge. Under the direction of Lt. Gen. Lincoln Faurer, the National Security Agency has taken over leadership for encryption.

Losses are not limited to the direct theft of funds through financial transfers or credit-card scams. Firms that maintain data on individuals—such as insurance companies, rating agencies, and banks—are susceptible to lawsuits by individuals whose accounts have been tampered with or whose personal data has been revealed.

State and federal rulings on the privacy of data have had a big impact in this area, spurring investment in security systems. Insurance companies with medical reports on file and credit bureaus with financial data are vulnerable to lawsuits if an individual's privacy is violated.

Inside jobs. According to International Resource Development Inc., companies say their overwhelming fear concerning their computer systems is the computer-literate middle manager who has enough knowledge—and the inclination—to sabotage or compromise data. This is why the market for security systems, software, and equipment is growing so rapidly, says senior analyst Maureen Fleming.

The firm breaks the market down into four levels of security devices. Physical-access and environmental controls, which include everything from computer-access cards to disaster recovery and off-site storage, should total $572 million this year and grow to $798 million for 1987. Data-communications and encryption products are expected to hit $91 million in 1985 and reach $121 million for 1987. The market for mainframe security software will amount to $51 million in 1985, International Resource Development believes, and $71 million by 1987. The microcomputer hardware and software market is expected to grow from $59 million in 1985 to $104 million in 1987.

In the banking and financial-services sector, buying security can run as low as $5,000 to $10,000. But, according to Joel Thomas, vice president of finance for Codercard Inc., sophisticated financial institutions are looking at security systems for data protection to the tune of $15 million to handle the needs of 80,000 users on 30,000 terminals—and that's just for the hardware and software from one supplier. Costs depend on the level of the system, the number of individuals requiring access, and the degree of security needed within the system.

Vendors of security systems say the problem of computer crime begins with the uninformed client who simply doesn't have the basic knowledge to anticipate vulnerable areas within the company. The client has to know what the needs are and then must translate these requirements to the supplier.

Silent fears. If the client doesn't want to talk about the problem for fear it will bring on more of the same problems, the security problem gets into a vicious cycle. To make matters worse, once a successful product or system is created, the client wants to keep it quiet, because then the hacker will be challenged to crack the system and the whole process thus begins again.

Codercard's Thomas says security is a relatively new field and until very recently was the responsibility of the computer programmer, who usually did not have enough knowledge about the problem.

Suppliers of security products or systems have to decide whether to base their products on security standards such as those being set up by the National Bureau of Standards or to develop proprietary systems that are custom-made for each client. The standards route offers clients a better legal stance for having met the applicable requirements, while the proprietary route may make a system impregnable or at least give a firm a better chance of avoiding being targeted by a criminal.

One supplier said the best approach is to help the client define the real value of the computerized data and calculate security as insurance.☐

SEMICONDUCTORS

TOPOLOGY SPOTS CHIP-MARKET BLIPS

Paris

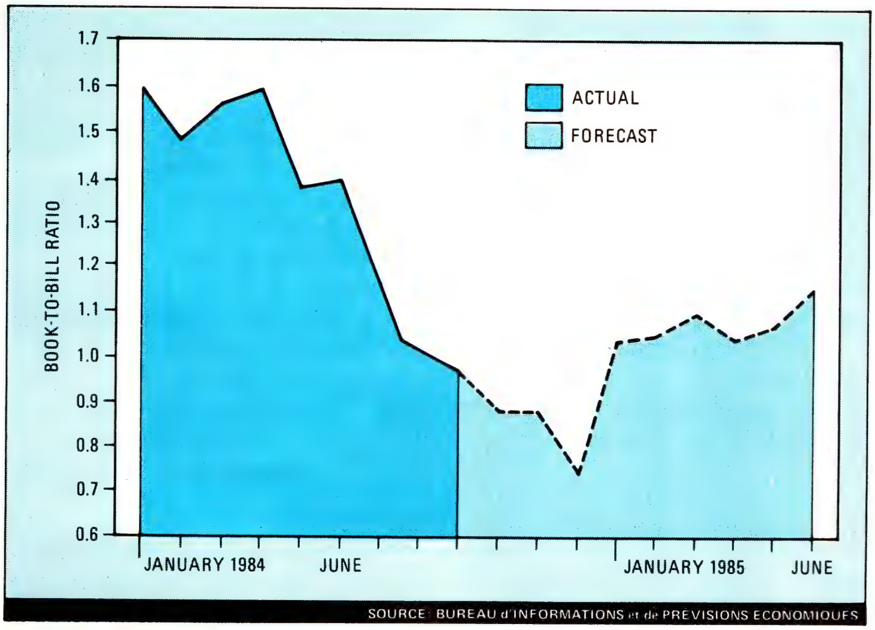
The only thing that surprises Jean-Michel Beaujean and Jean-Marc Altwegg about the roller-coaster-like plunges and ascents of the semiconductor market is that industry executives still find them surprising.

The two economists are with the French Bureau d'Informations et de Prévisions Economiques in Neuilly, just outside Paris. Beaujean is a components analyst and Altwegg directs the electronics section.

Detecting a pattern. They've noticed over the years that whenever the semiconductor market takes one of its free falls or goes into one of its nearly vertical climbs, the industry's marketing managers are invariably left scratching their heads, because they had predicted far more orderly change. But the BIPE economists think that they might have found the clue that explains the phenomenon.

Two factors distinguish their analysis of the volatile industry. First, they give far more weight to data received from semiconductor consumers—such as their stocks, production rates, and ordering plans—than from components manufacturers. "The way that most industry forecasts are done is that you get together representatives of all the semiconductor suppliers and ask them what their opinion of the market is," explains Altwegg. "What you get by working that way is a kind of collective intoxication."

The second factor is that, when they've gathered their data, Beaujean and Altwegg analyze it using "Catastrophe Theory," a series of topological models devised by French mathematician René Thom. His theory sets up a mathematical scheme to help explain abrupt and normally unpredictable events in nature, such as earthquakes, volcanic eruptions, and heart attacks.



SOURCE: BUREAU d'INFORMATIONS et de PREVISIONS ECONOMIQUES

Roller coaster. Economists at the BIPE say that René Thom's topology-based "Catastrophe Theory" can help to explain the chaotic behavior of semiconductor book-to-bill ratios.

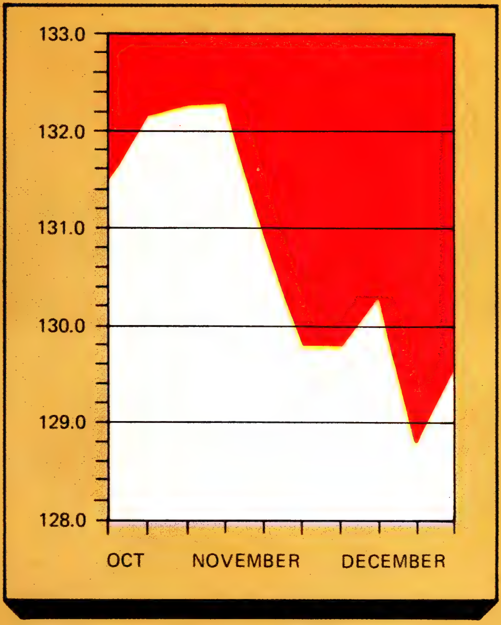
"The problem with traditional mathematical analysis is that it is linear, so it leads you to predict smooth evolution," points out Beaujean. "But the semiconductor business doesn't work that way. What really happens is that as soon as there is the slightest lengthening of the delivery cycle, people begin to overorder. As the delays get longer, customers order more and more, sending the book-to-bill ratio skyrocketing until those same customers are swamped with overstocked components. Then the bottom falls out of the market."

Skeptics believe. Beaujean recalls that in March, after using the method of analysis developed at the BIPE, he was predicting that book-to-bill ratios would be below 1:1 by the end of 1984 (see chart). And though people were skeptical at first, some have come around.

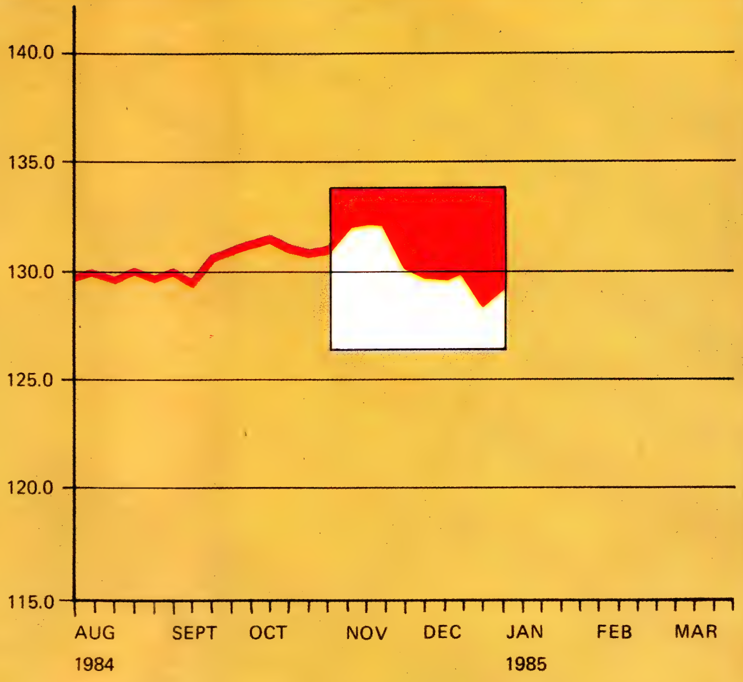
"Frankly, I was very wary of their method but, in retrospect, you have to admit that they called the downturn right on the nose," admits Philippe Dauvin, chief economist for the Components Division of Thomson-CSF. "I'm probably going to end up being a believer."

The BIPE analysis of the outlook for France's electrical and electronics industries through 1989—including the components sector—is available in a detailed report, titled "Tric-Tronic." **–Robert T. Gallagher**

ElectronicsWeek Index



THIS WEEK = 129.6
LAST WEEK = 128.8
YEAR AGO = 121.0
1982 = 100.0



The *ElectronicsWeek* Index, a seasonally adjusted measure of the U.S. electronics industry's health, is a weighted average of various indicators. Different indicators will appear from week to week.

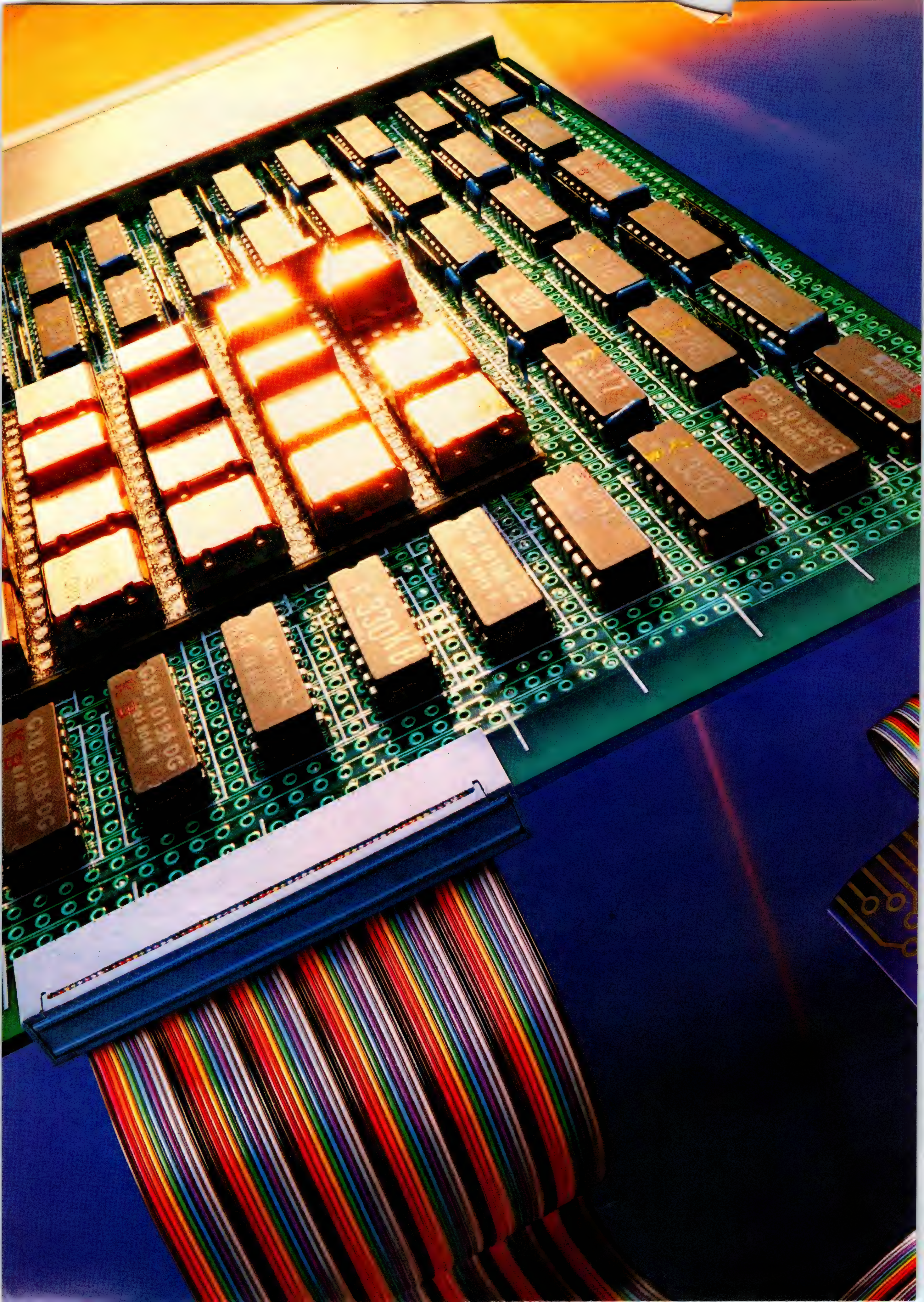
U.S. ELECTRONICS INDUSTRY SHIPMENTS

	November 1984	October 1984	November 1983
Index of leading economic indicators	166.6	164.5	162.5
Budgeted outlays of the federal government ($ billions)	79.956	81.037	67.794
Budgeted outlays of the Department of Defense ($ billions)	22.017	20.643	17.416
Operating rate of all industries (% capacity)	79.9	79.6	77.3
Industrial-production index	165.0	164.3	155.3
Total housing starts (annual rate in thousands)	1,528	1,538	1,730

U.S. GENERAL ECONOMIC INDICATORS

	November 1984	October 1984	November 1983
Shipments ($ billions) Communications equipment	4.924	4.568	4.405
Radio and TV receiving equipment	0.847	0.855	0.716
Electronic and electrical instruments	4.639	4.660	4.304
Components	3.703	3.785	3.232

A mixed performance for equipment shipments in the electronics industry helped bump up the *ElectronicsWeek* Index 0.6% in the latest week. Within the shipment statistics, consignments of communications equipment jumped 7.8% in November, according to the most recent Commerce Department data. Shipments of radio, TV, and electronic instruments slipped slightly, however, and shipments of components fell 2%, reflecting the semiconductor industry's slowdown. U.S. government defense outlays rose 6.7%.



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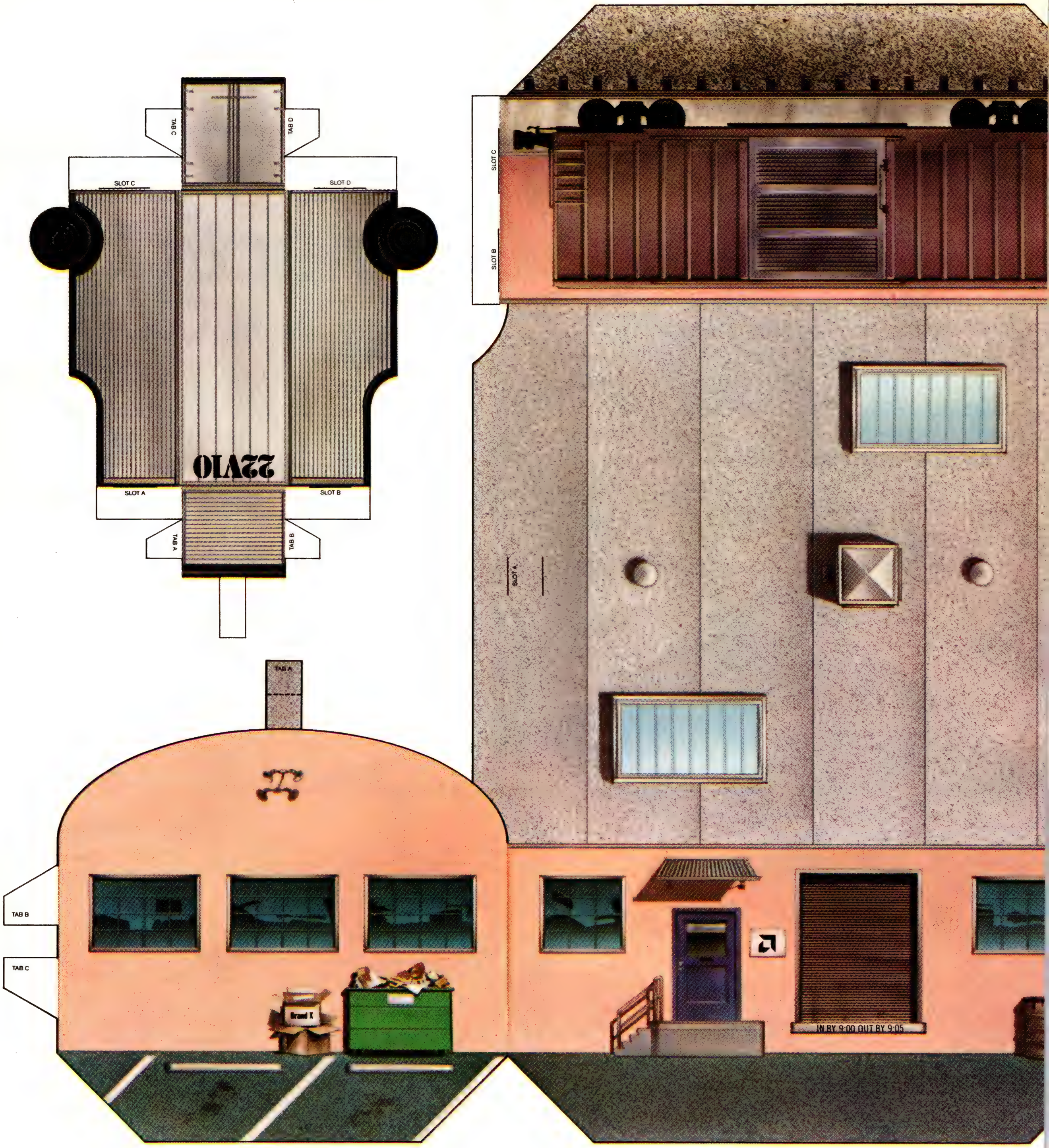

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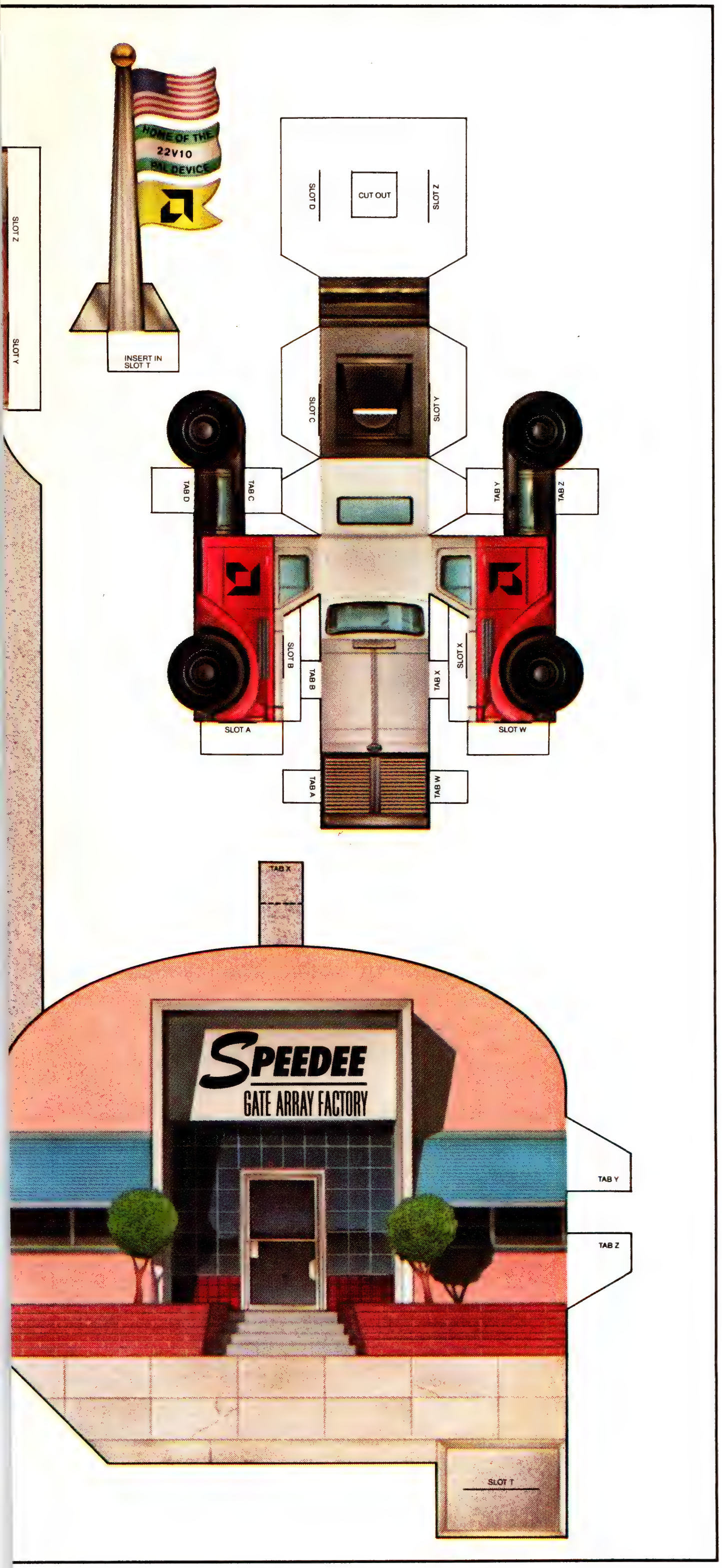
GATE ARRAY FACTORY.



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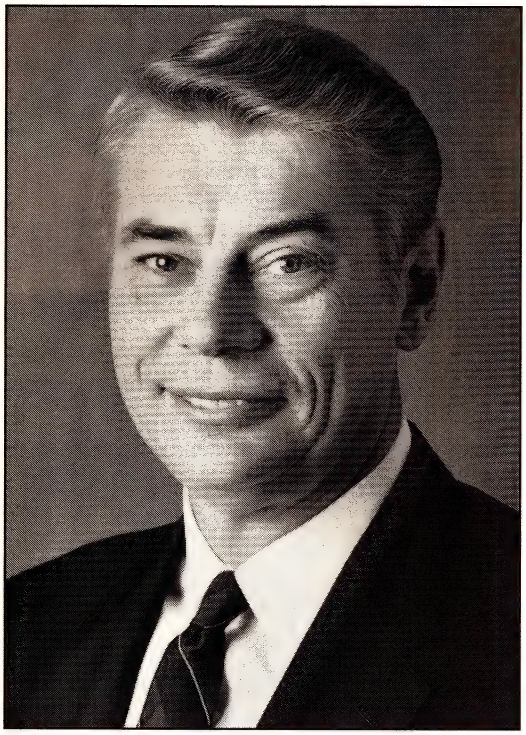
NEW VARIAN PRESIDENT SET FOR THE LONG HAUL



Decentralist. To handle the size and wide variety of Varian's markets more efficiently, Jerome J. Meyer wants more responsibility turned over to divisions.

Palo Alto

Varian Associates Inc. has signaled the completion of a tough three-year turnaround period that saw the entry of several company outsiders to top executive posts. That trend may end, however, with the appointment of new president Jerome J. Meyer, who also fills the newly created position of chief operating officer. Interested in promoting people from within, "one of the first things I'm going to look at is the line of succession," he says.

Considering the size and wide variety of markets Varian is in—from microwave tubes to semiconductor-manufacturing equipment to medical imaging instruments—"more responsibility has to be turned over to divisions," Meyer says. His management credo is, "I am a decentralist."

To implement this structure, he will have to be as conscientious in managing the people below him as in meeting the operating plan. If he does not give people management a high priority, "we'll outstrip our middle-management talent," Meyer explains. He sees management grooming as necessary to a growing company that surpassed the $1 billion mark in orders for fiscal 1984 and expects 25% revenue growth in 1985.

Meyer, 46, learned his lessons during his 18 years at Sperry Univac, where he rose from engineering management assignments to general manager, international, for its Defense Systems Division. Most recently, he worked for Honeywell Information Systems, where he was head of five divisions in the Systems Group. He says it was there that he received "the reaffirmation that people run companies."

The biggest difference between Honeywell and Varian is the product categories, he has found. Varian serves "relatively small markets—$750 million to $1 billion—but has a relatively high share in them," Meyer notes. His group at Honeywell was competing in a $30 billion market. Although he foresees Varian involved with more computerization as it serves the need for integrated lab equipment, he does not plan a change in the company's character.

International presence. Besides bolstering the management personnel to support that portfolio, Meyer says that Varian will be investing heavily in capital equipment next year, spending more than $100 million. Examining Varian's traditional marketplaces, he says the company will "have to look at our international presence."

Although Europe has been its biggest overseas market, Meyer sees great potential for the company in Japan, Korea, and particularly in the People's Republic of China. Varian "seems to have a unique and fine presence in China. The company has gone in very low-key and worked with technical centers. Varian seems to understand PRC mechanisms as well as anyone I've seen in these areas."

–Eve Bennett

Hutcheson meets challenge of new fabrication line

Austin, Texas

Past experiences in MOS product planning, along with efforts to hold down chip costs through yield improvements, have given Randy R. Hutcheson a clear view of what is sizing up to be a big challenge for the newest and most advanced fabrication line at Motorola Inc.

As microprocessor device engineering manager, Hutcheson is responsible for easing some of Motorola's most complex 8-, 16-, and 32-bit designs onto the new MOS 8 fabrication line, which started running its initial lots during the past year. With the 32-bit 68020 microprocessor just starting to ramp up in volume production on the line, Hutcheson sees even more complex peripheral family members on the product-portfolio horizon.

Parts get bigger. Many microprocessor-peripheral chips end up being larger than the original family host, notes Hutcheson. During the 68020's unveiling last summer, for example, officials put the 32-bit central processor at 375 by 350 mils. Some of Motorola's newest 68000-

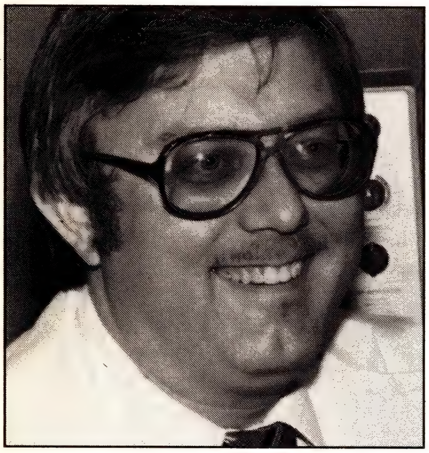
family peripherals are expected to have chip sizes as much as 30% to 50% bigger than the 68020.

"Part of the interesting thing is that customers generally will agree to pay more for microprocessors because they think they are harder to make. But when it comes to peripherals, the perception is often that they are less complex and should cost less," he notes. That often results in peripheral chips that press the processing technology to yield smaller device geometries to trim die areas and costs, adds Hutcheson.

The 34-year-old native of Lincoln, Neb., received his BSEE from the University of Nebraska in 1973 and began his engineering career with Motorola in Phoenix, Ariz. For four years, he managed the firm's single-chip microcomputer front-end, back-end, and test department. Before being named microprocessor device engineering manager, Hutcheson was strategic marketing manager for MOS telecommunication circuits from 1982 to 1984.

Now, he watches over the transfer of new processes and processor products from the development labs to the high-volume MOS 8 line, which is the first of a whole new breed of front-ends at Motorola. "Often the vendor of this production equipment cannot help you out much because it is also blazing new trails," says Hutcheson.

–J. Robert Lineback



Easin' on down. Randy Hutcheson is responsible for easing some of Motorola's most complex microprocessor designs onto its new MOS 8 fabrication line.

Catalano burns up the track with a super-fast prototyping outfit

Melbourn, England

John Catalano, a founder and technical director of UK startup Array Logic Ltd., will be blazing a gate-array trail with a superfast, seven-day prototyping service aimed at the small user who needs as few as six prototype chips. The company, located near Cambridge, will provide key chip-making skills in house.

Aside from packaging and testing, which many other outfits provide, the firm is laying on a fast and flexible electron-beam machine that can lay out several different masks on the same wafer. It is also installing clean-room facilities with process equipment to wire up—or lay down the metallization patterns for—gate arrays using either dielectric or polyamide isolation. Array Logic can currently handle 2-μm, two-layer metallization, and Catalano expects to develop the four-layer interconnect capability needed to cope with even denser chips.

Such high-tech skills do not come easily or cheaply. The 36-year-old Catalano not only provides the needed chip-making expertise in interconnect technology, he is also charged with setting up a slickly running mask-making operation.

The task will draw on Catalano's 12 years in semiconductor research and development. After gaining his doctorate in solid-state physics and materials engineering, Catalano joined General Electric Co., Schenectady, N.Y., where he researched electron-beam-addressed megabit memories. He then joined Racal Electronics Ltd., Bracknell, Berkshire, to direct its microelectronics research and guide the development of the company's in-house gate-array program.

His next move was to PA Technology, a research and consulting company in Melbourn. There, Catalano and Bob Whelan, now managing director of Array Logic, began hatching plans for a silicon foundry broadly based along lines that Carver and Meade proposed.

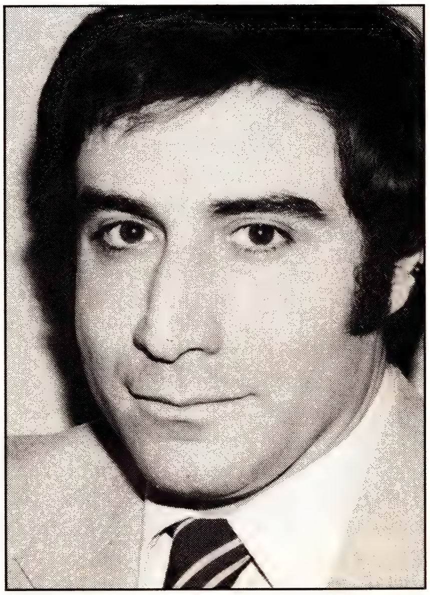
They thought there was room for a new kind of service operation, placed between the customer and the chip supplier, to handle the small prototyping work that the chip makers are not set up to handle. Once a customer was ready for volume production, the chip maker would take over.

Close ties. Besides nurturing the idea, PA Technology also fronted a consortium of investors backing the startup team with an equity funding of $4.8 million. This was the first time that PA had spun off its research into a new company in which it had an equity stake, and the links between the two companies will still be close: Array Logic's first unit is on PA Technology's Melbourn site.

The idea has proven attractive to others as well. British chip makers Ferranti Ltd. and Plessey Semiconductors Ltd. have concluded agreements with Array Logic to make available their design systems and process rules, so Array Logic will also be taking on chip designs.

Similar deals are in the works with U.S. chip makers. This means that from the outset Array Logic will be able to offer a full line of CMOS and bipolar processes and do everything from chip design to packaging and test. If its first venture is successful, the company expects to set up clone operations, each serving the local market, with the U.S. first on the list.

–Kevin Smith



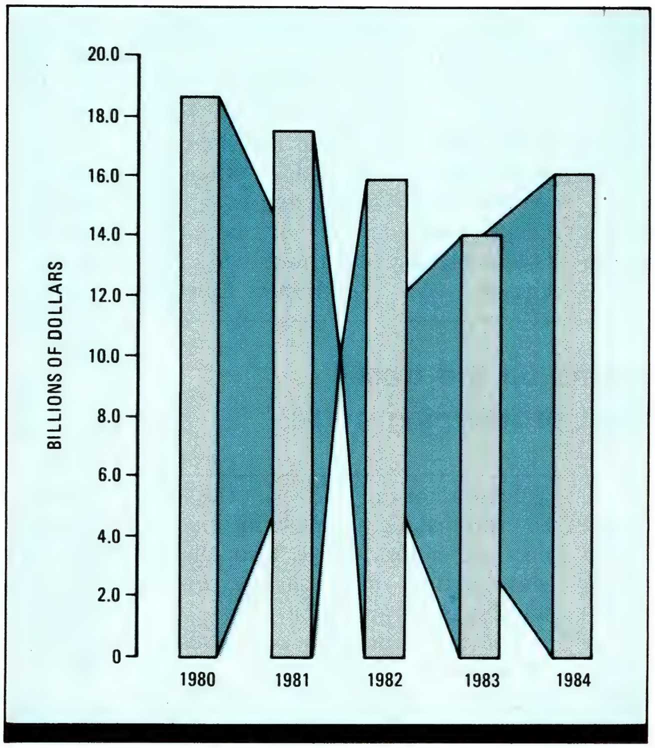
Squeezed in. John Catalano acted on the idea that there was room for a new kind of smaller prototyping service operation placed between the customer and the chip supplier.

Companies

ITT INVESTS IN EUROPEAN UNITS TO CRACK U.S. TELECOM MARKET

Frankfurt, West Germany

At a time when many U.S. companies are retrenching or holding back investments from Europe and are increasingly turning their attention to lusher home markets or Pacific rim countries, ITT Corp. has become one of the few U.S. corporations to buck the trend.



Up and down. ITT Corp. had revenues of $14.2 billion from its manufacturing operations in 1983, versus almost $16 billion in 1982. In 1984, revenues from these operations could hit $16.3 billion.

The New York-based ITT, the world's biggest conglomerate, with 1983 revenues of more than $20 billion, has embarked on a program of massive investment in its European affiliates. From 1985 through 1988, it will spend some $5 billion for research and development as well as for plants and equipment at its companies in Belgium, the UK, Italy, Spain, Austria, West Germany, and elsewhere in Europe. Most of the money will go to affiliates engaged in communications and related fields.

That's a well considered step, industry observers say. The rationale: ITT is determined to move into the huge, as well as lucrative, U.S. telecommunications market—a market that commands about one third of worldwide equipment sales. To finance the drive, ITT is selling off some of its non-electronics businesses.

More needed. But that, apparently, is not enough. With no strong customer base in the U.S., ITT must capitalize on the R&D expertise of its European subsidiaries and draw on their range of equipment to help it penetrate the home market. So, strengthening its network of European electronics companies seems to be a wedge with which ITT plans to crack the hotly contested U.S. telecom arena and ensure itself of a strong position in it.

In Western Europe, ITT's image is that of a strong telecommunications house rather than that of a conglomerate with interests in hotels, insurance companies, and other fields, although some foreign ITT firms are also engaged in nontechnical areas. It is known as an innovator in communications, doing a thriving business with European postal administrations, armed forces, and air-traffic authorities.

With 133,000 workers in scores of plants and finance institutions, ITT did some $6.8 billion worth of business in Europe in 1983. That is about half of the firm's worldwide sales, if revenues from its insurance business are excluded. Earnings by its European firms in 1983 came to about half a billion dollars, or 60% of ITT's total earnings.

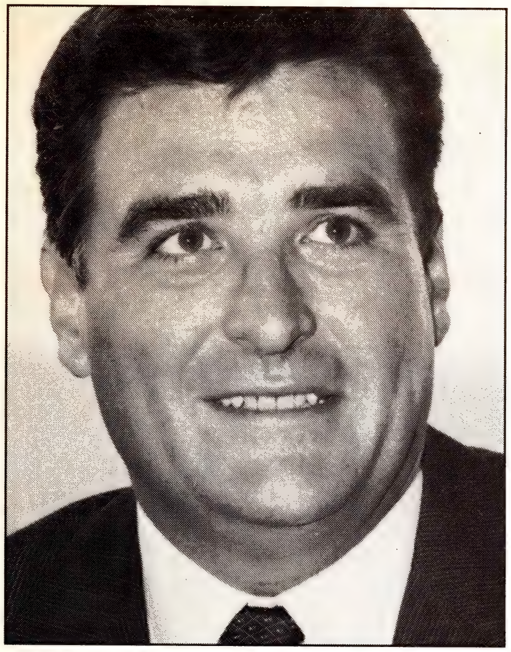
Of the European countries in which ITT has a strong representation in communications, West Germany will get the lion's share of the investment money: around $2.1 billion from 1985 to 1988. That's 50% more than what the firm dished out in that country during the previous half decade.

The reason for the heavy involvement in Germany is the country's economic policy. As Daniel P. Weadock, president of ITT Europe, pointed out here recently, thanks to the promotion of high technology and a drive for stability, Germany "has all the prerequisites to attract investments." German interest rates are fairly stable, inflation is low, and the deficits in the public sector are being reduced.

Further, "tax reductions in the private sector are in the offing, which should stimulate the market for consumer products," Weadock says. Also, the demand for capital goods both by industry and government is brisk, and, because of lively export activities, West Germany has a positive balance of trade.

That could change, Weadock cautions, "but the fact that economic balance has been maintained during the difficult times of the past years gives me confidence that West Germany will steer a stable course." Government policy is also aimed at keeping the country competitive and at being Europe's front-runner in closing the technological gap with the U.S. and Japan.

The 50-odd ITT firms in West Germany, valued at around $7 billion, employ about 51,000 people and sold close to $2.5 billion worth of goods and services last year. Besides industrial enterprises, the group in-



Beneficial. "West Germany is a good country in which to invest," declares Daniel P. Weadock, president of ITT Europe. So the corporation has earmarked a big chunk of its investment money for that country.

cludes insurance and financial services firms, as well as three hotels.

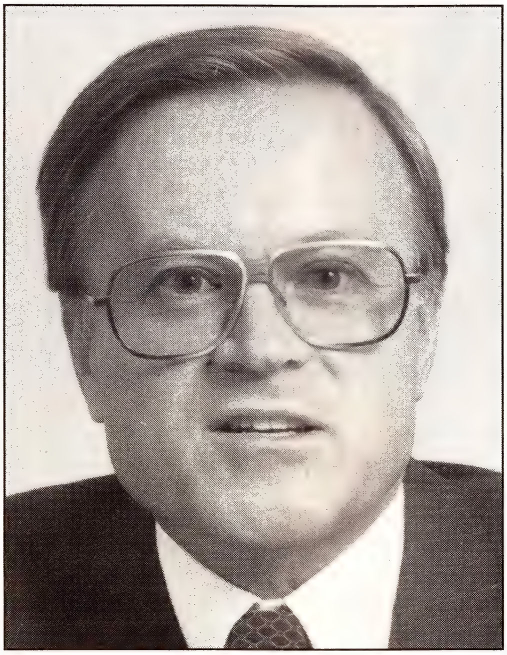
By far the biggest firm in the German group, and also the biggest production firm in the ITT family of companies, is Standard Elektrik Lorenz AG, in Stuttgart, a heavyweight in communications. With its 30,000 employees, SEL chalked up sales of about $1.5 billion last year, 30% derived from exports, and accounted for more than half of ITT's revenues in West Germany.

Best seller. By investing strongly (about 11% of sales) in R&D, SEL has successfully made the transition from a firm heavily engaged in electromechanical switching systems to an innovative high-tech company. Its System 12 digital switching equipment, which was developed in conjunction with other ITT affiliates, promises to become a best seller in markets outside the U.S. It has been selected as one of two systems that West Germany's Bundespost, the Ministry of Posts and Telecommunications, will install nationwide. The System 12 is now being adapted to U.S. specifications.

Given SEL's stature, it is not surprising that a hefty amount—about $1.3 billion—of ITT investment money for Europe has been earmarked for it. Of that, $900 million is slated for R&D with the rest for plant and equipment.

Another major recipient is Alfred Teves GmbH in Frankfurt, a $600 million brake manufacturer that is the world's biggest. It is to get $330 million for R&D and $120 million for capital investment. Teves antiskid systems are being installed on two U.S. car models made by General Motors and Ford. They will soon turn up on German-made cars.

In the chips. Then there is the digital-TV-system pioneer Intermetall GmbH, the lead house of the ITT Semiconductors group that's in for substantial funds. This chip maker in Freiburg is slated for $180 million during the next five years. Of that amount, $110 million is for plant and equipment and the rest for R&D. Its digital-TV chips, meanwhile, are going to more than 20 TV producers around the world.



Innovative. "The big investments are to promote the design of VLSI circuits and digital systems and push the use of the latest design and manufacturing techniques," says Helmut Lohr, president of ITT's Standard Elektrik Lorenz AG subsidiary.

These R&D investments, says SEL president Helmut Lohr, are to promote the design of highly integrated circuits and digital systems. The capital investments, he adds, "are intended to push the use of computer-aided-design techniques, computer-aided and computer-integrated manufacturing, flexible automation, and process optimization."

As a result of the outlays in West Germany, ITT expects sales of its affiliates there to increase 65%—to more than $4 billion—by 1989. Exports should rise even faster—from $600 million now to $1.3 billion by 1988. They should then account for one third of total sales by West German ITT companies, up from 28% now, Lohr says. **–John Gosch**

BOTTOM LINE

Going up. Companies in Silicon Valley expect the labor situation this year to remain tight and competitive, with a continuing upward pressure on salaries. These companies will also give workers higher raises than other firms in the Bay Area. That's the view of the Wyatt Co., a San Francisco actuarial and compensation consulting firm that studied projected 1985 wage plans of Bay Area companies. Wyatt says budgets for salary increases for middle managers of major high-tech firms average 8.7% of payroll versus 6.6% for other firms. Middle managers include engineers, scientists, and other professionals, but other employees are also getting higher raises. Wyatt says projected budgets for salary raises for secretaries and assemblers will average 8.5% of payroll in 1985, compared with 6.5% for other industries.

LAN sakes. Revenues for 3Com Corp. in Mountain View, Calif., surged 222% in its second fiscal quarter, to $13.2 million from $4.1 million a year ago. Earnings in the period, which ended Nov. 30, 1984, rose 111% from $664,000 to $1.4 million. 3Com, which offers local-area networks for personal computers, said incoming orders were lower than expected. The firm says that IBM Corp.'s introduction of its PC Net system may have caused some customers to re-evaluate their LAN purchase decisions.

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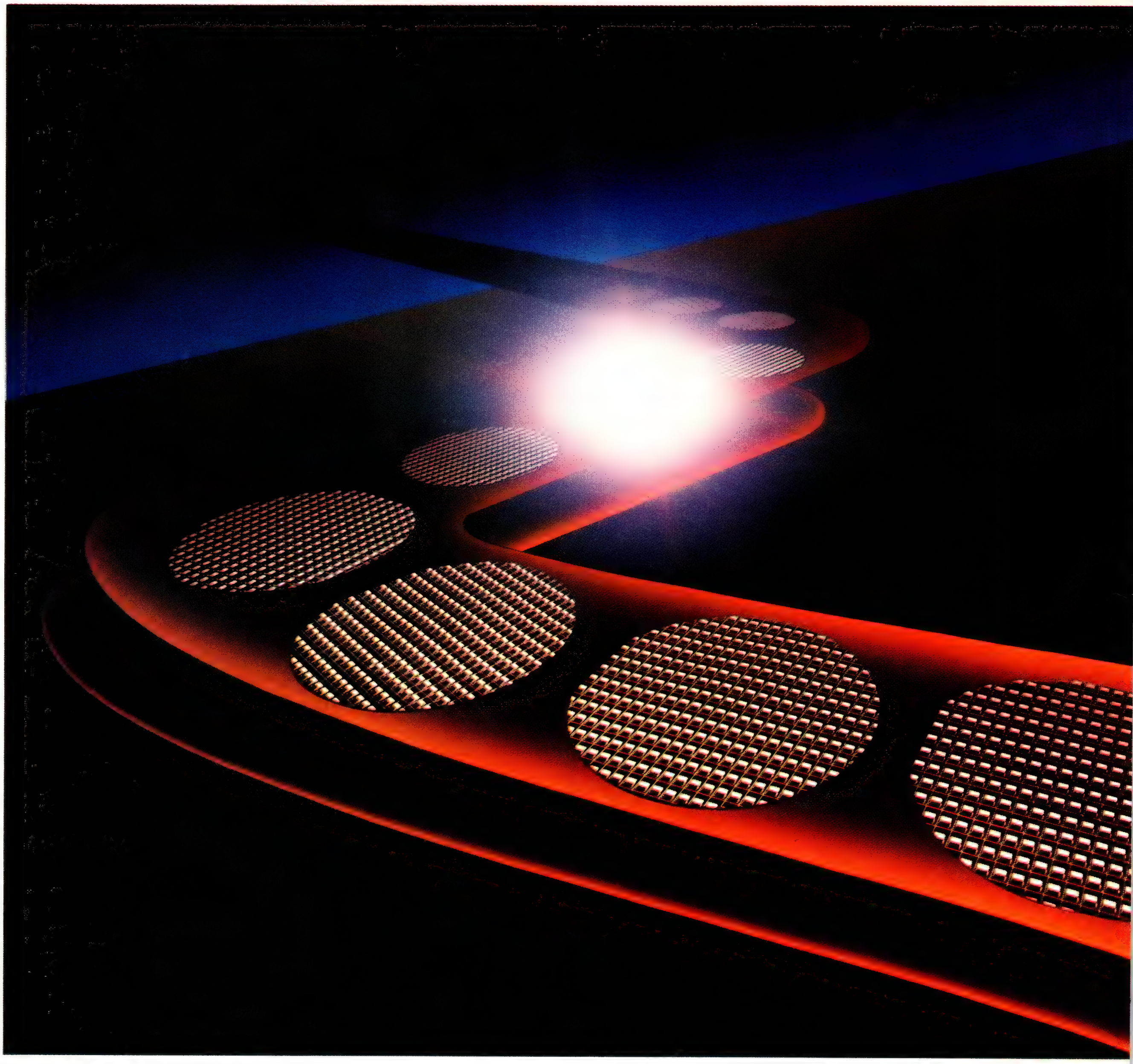

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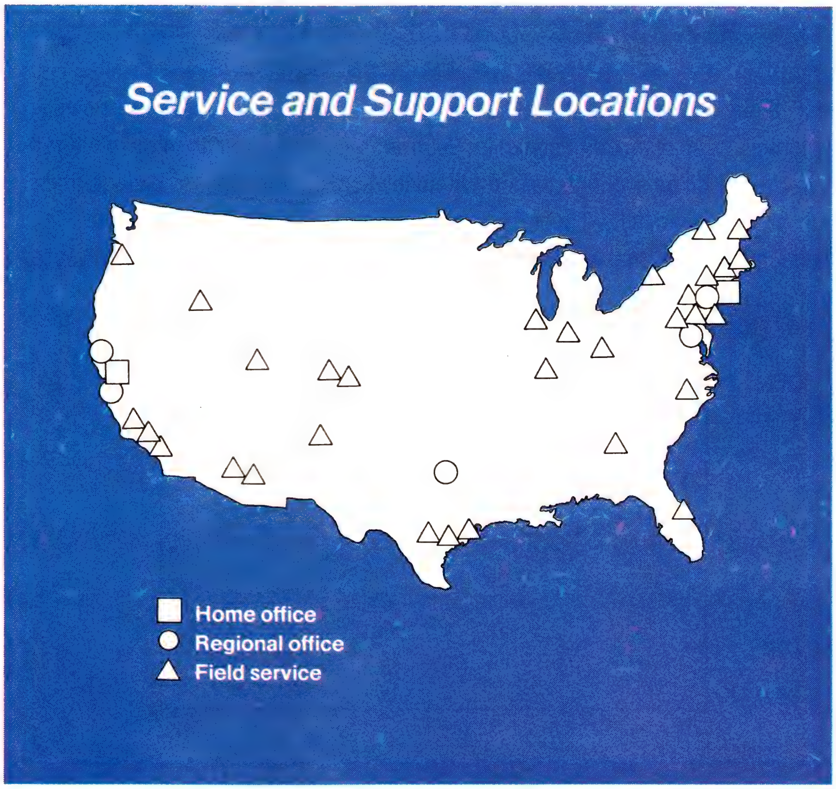
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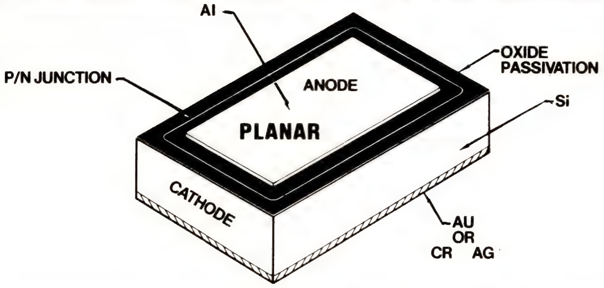

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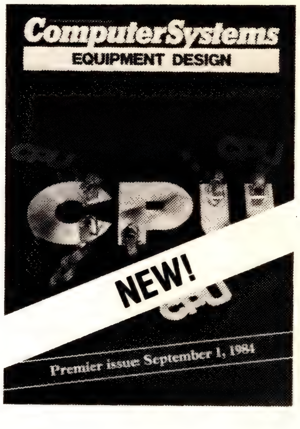

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SATELLITES— THE PUSH IS ON

Technological barriers have fallen, and satellite operators struggle with ways to make services attractive

☐ *by Terry Feldt*

Only 25 or so commercial communications satellites currently serve North America, but the total number could increase sixfold by the end of the decade if each of the existing plans for new construction is carried through. The quantum increases in available capacity are opening up the medium to more and more applications—from traditional users such as common carriers and broadcasters, to corporations, and ultimately to individual households.

Meanwhile, advances in technology are pressing ever closer to the theoretical limits of each transponder's capability. The new generation of satellite components promises to make near-optimal use of allocated frequency bands and geostationary arcs, or the minimum spacing allowed between adjacent satellites that share the same set of frequencies.

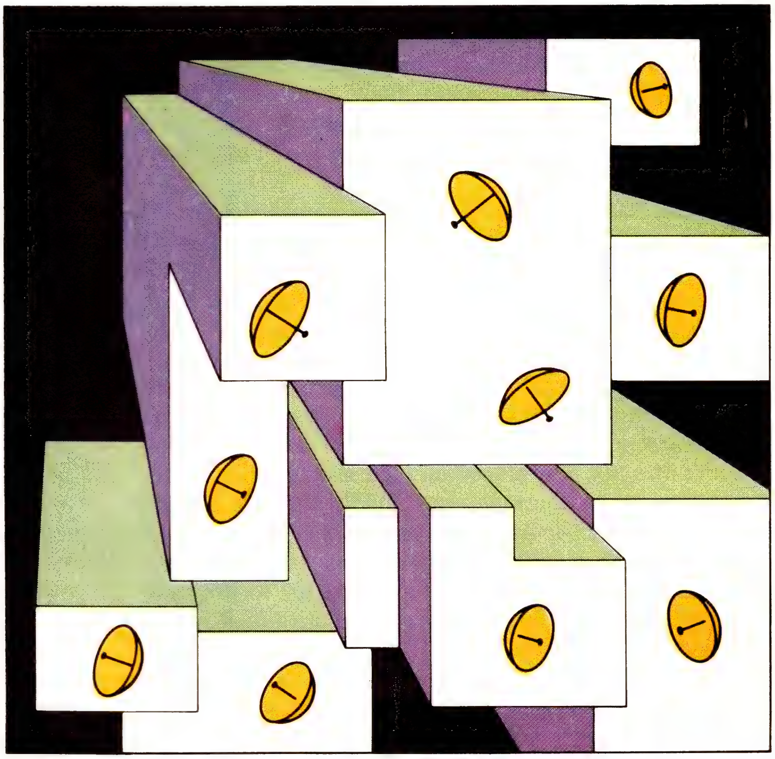
Moreover, the inherent shortcomings of satellite communications, such as attenuation in the higher bands during heavy rain and an excessive two-way propagation delay, are rapidly being circumvented by a potpourri of design enhancements to transponders, earth stations, and end-user equipment. What is left is a swelling army of geostationary transponders that offer not only a large capacity but also a tremendous potential for interconnection of additional facilities.

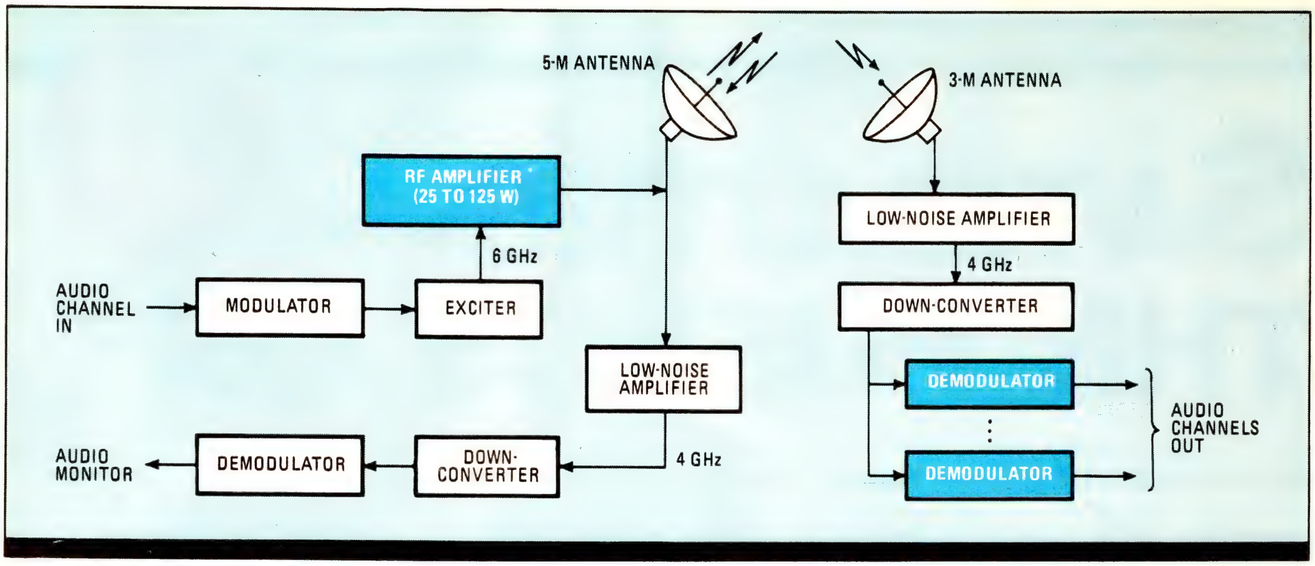
However, the need to construct earth stations is a major drawback of the medium. A further technological challenge is in finding ways to allocate a single transponder's capacity among multiple transmitting earth stations. Hopes run high that the upcoming fixed- and moving-beam satellites operating in the Ka band—that is, 30-GHz uplink and 17-GHz downlink—may be partial solutions.

Broadcasters and voice common carriers traditionally have been the dominant users of commercial communications satellites. The explosion of cable TV, in fact, would likely not have taken place if satellite transponders had not provided economical means to hop programming to local head ends: running a dedicated terrestrial link for each program source to so many locations was not feasible. Today, commercial TV programming is relayed through the C-band transponders of the Hughes Galaxy 1, the RCA Satcom-3R, the Western Union Westar-5, and several other satellites as well.

Audio transmission

The transmission of audio broadcast signals is another area in which satellites have made inroads. By using single-channel-per-carrier (SCPC) techniques, a single satellite transponder has the capability of relaying dozens of independent audio sources. With 10-dBW carriers leased from satellite common carriers, networks with nationwide coverage have been established that provide





1. Sharing transponders. The uplink station of a single-channel-per-carrier system has to transmit only a fraction of the power of full-transponder C-band uplinks. With multiple demodulators, downlink stations can receive multiple audio channels from the same transponder.

news feeds and special-events programming to local radio stations (Fig. 1).

Regional broadcasters are also finding that by leasing a 10-dBW carrier, they can bypass local terrestrial station-to-transmitter links and recoup their initial equipment investment within several years. Microdyne Corp., Ocala, Fla., is one supplier of SCPC network components. The firm has uplink antennas 5 m in diameter and downlink antennas as small as 3 m. The company also provides turnkey installations and on-site servicing to its client radio stations.

Private nets abound

Satellite technology has also opened up the door for private networks—economical facility-to-facility data communications, Telex, facsimile, and videoconferencing services—all becoming increasingly necessary to today's large corporations. For voice communications, the availability of satellite capacity has likewise provided an attractive cost-per-channel alternative that is in many cases more economical than microwave- and fiber-based long-haul carriers.

In sum, satellite communications is providing more and more relief to crowded long-haul telecommunications circuits, frequently with users sharing earth stations. Argo Communications Corp., New Rochelle, N.Y., is one company that has placed earth stations in major U.S. cities.

A corporation deciding to lease or purchase earth stations for the ground segment and a companion space segment (or some transponder capacity) ultimately must consider the tax advantages of such a setup. The initial investment versus the long-term savings that are possible with satellite telecommunications further recommends this medium as an alternative to time-shared hardware.

Frequently, the high initial outlay needed to use satellite technology for in-house telecommunications is balanced by favorable investment tax credits and depreciation allowances. The opportunity to avoid interconnection charges with local Bell operating companies can be another advantage of satellite use.

Comsat General Corp., Washington, hoping to make corporations more comfortable with the notion of bypassing local loops by means of satellites, is constructing backbone systems—networks that primarily serve a large, high-priority customer with an ongoing service. Such a network can then also benefit many smaller users, each with more modest communications requirements.

One example of a backbone system is Comsat's program-distribution system for National Broadcasting Co., New York. The system's primary objective is to replace the conventional mix of terrestrial and C-band links—6-GHz uplink and 4-GHz downlink—with one Ku-band—14 GHz uplink and 12 GHz downlink—satellite-based network for program distribution from New York to most of the 170 NBC affiliate stations.

The capability for uplinking from NBC's Burbank, Calif., studios—as well as from several affiliates—allows for backhauling programs to New York, where wide-area distribution originates. Uplinking is feasible from any point in the system.

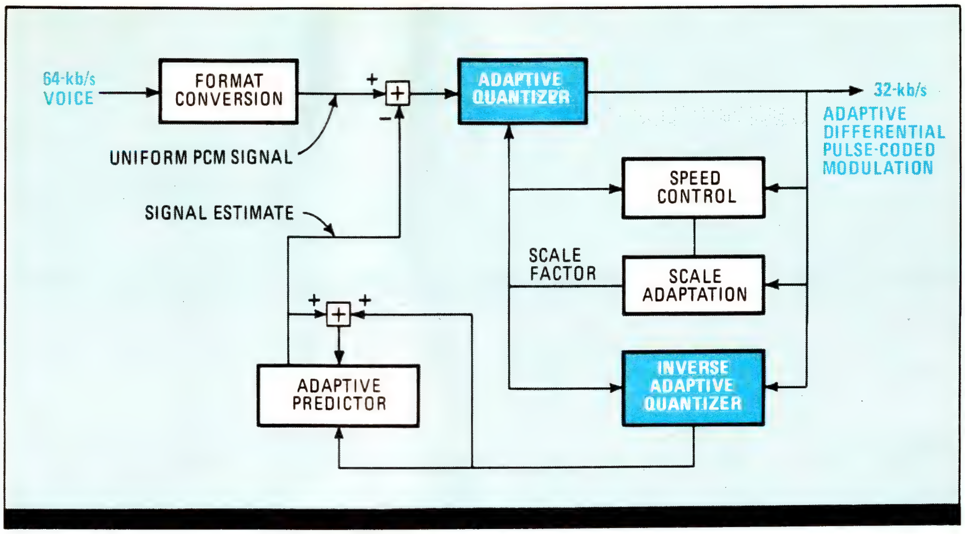
A secondary purpose of Comsat's satellite network is to provide Ku-band satellite access to other businesses, which can be located in practically any U.S. city. Use of the Ku band prevents interference from terrestrial microwave links, so earth stations can be placed in nearly any location within the satellite's line of sight. This backbone approach is a double-edged strategy to undercut both terrestrial carriers and other satellite-based carriers.

More capacity

Competition, intense within the satellite common-carrier and -owner community, also comes from traditional terrestrial-based carriers. The drive, therefore, is to squeeze more satellites into the same geostationary arc and more capacity into the same frequency bands. Once a transponder is in place, raising its information-handling capability lowers the prorated cost of its use.

To this end, much work is under way to develop transmission methods for more efficient satellite communications. Advances in these areas have an impact on telecommunications applications across the board. The cost of more sophisticated processing hardware to increase the efficiency of a transponder is frequently offset by the reduced satellite facilities required. Or the cost is offset by the time it would take to add a new facility route, if facilities relief is called for. Common carriers, as well as private network owners, stand to benefit from the advances.

For digital videoconferencing, implementing compression techniques to tradeoff minimal picture degradation for greatly reduced data rates now looms as a plum technology area. The alternative to video compression is limited-motion and freeze-frame video. At the high end, video-compression techniques are now capable of 56-kb/s rates [*ElectronicsWeek*, Sept. 24, 1984, p. 64].



2. Low rate. In the adaptive differential pulse-code-modulation encoder, the adaptive quantizer—as well as its inverse—converts digitized voice between uniform pcm's resolution of 8 bits per sample to 4 bits per sample for the new CCITT standard.

Systems integrators have several options for reducing voice-data rates. The current standard is 64 kb/s for pulse-code modulation (pcm). The use of statistical multiplexing and digital speech interpolation techniques can more than double a transponder's voice-handling capacity. In addition, a variety of techniques for compressing the basic voice digitization rate down to 32 kb/s or lower are under consideration.

The International Telegraph and Telephone Consultative Committee, for example, has approved as an international standard a transcoding algorithm for halving the 64-kb/s data rate of digitized voice, including voice-band data. This adaptive differential pcm (ADPCM) algorithm employs both adaptive quantization and adaptive equalization (Fig. 2).

For implementing the ADPCM standard to most existing North American networks, however, some technical obstacles have to be overcome. One such problem is working around the current bit-robbing method for pcm signaling. In a voice channel compressed by ADPCM, such a technique would cause severe mistracking distortion. One channel separate from the channels carrying voice can be dedicated to carrying the signaling information, although this option cuts down somewhat on the 2:1 capacity gain that is otherwise possible.

Companded ssb

But it is in the transmission of analog voice channels that satellite technology has achieved its biggest gains. The conventional means to handle analog voice has been with FM channels carried in bulk through frequency-division multiple access. Long-haul voice carriers, however, have recently started to employ companded single-sideband modulation instead of FM.

Companded ssb can significantly increase the capacity of transponders already placed in orbit—the basic technique used is similar to the one that has increased the circuit-handling capacities of terrestrial microwave links. Placing a compander in each voice circuit allows for a satellite transponder power-per-channel that is lower than with uncompanded FM.

Typically, an FM-based system with 36 MHz of bandwidth can handle 2,800 one-way voice channels. But with earth-station equipment manufactured by California Microwave Inc., Sunnyvale, Calif., a 36-MHz satellite transponder's capability is boosted to 7,200 companded ssb-modulated voice channels (Fig. 3).

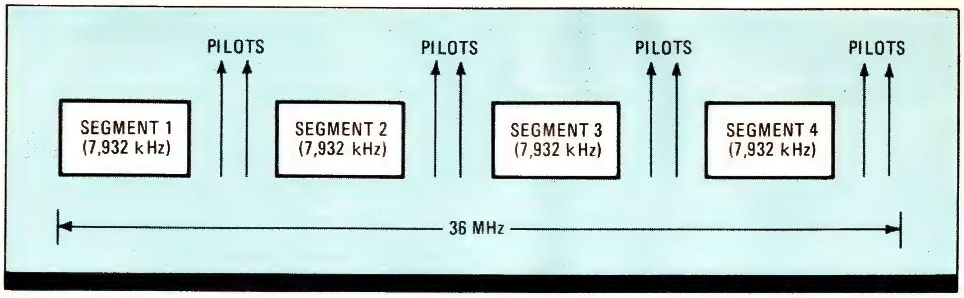
For the immediate future, however, the most noteworthy aspect of satellite technology is that it is moving beyond the corporate environment, to bring direct-broadcast satellite services to the home. DBS service in the U.S., downlinked on 12.2- to 12.7-GHz of the Ku band, is primarily aimed at the millions of households that the cable industry does not currently serve. Over the last several years, however, the DBS concept has evolved into much more than a distribution system for filling the needs of households without cable service.

More services

What is envisioned now are enhanced-quality video, menu-driven and password-protected program selection, and home data services—all are on the agenda for DBS systems. Still, DBS operators realized from the start that for DBS installations to find their way onto enough rooftops, certain technological barriers had to be overcome to make the service desirable and economical for the consumer as well as secure for the program distributor.

One challenge for DBS is raising the transponder power to lower the size and cost of the earth-station dish that the consumer must invest in. Another obstacle is the need to establish enhanced data services and simple procedures for billing, while locking out unauthorized viewers.

Up until now, some homeowners have opted for the reception of C-band-satellite TV signals that are intended for local cable distribution. Installing a TV receive-only (TVRO) C-band earth station is a costly proposition, but after one is planted, there is a wide range of program-



3. Stacking traffic. With companded single-sideband technology, the 36 MHz of bandwidth available from a satellite transponder can be partitioned into four segments of about 8 MHz, with each segment handling two 900-channel groups of voice traffic.

ming available free of charge.

TVRO users, however, will find they have fewer and fewer premium channels available for free viewing. One example of the cable industry's moves to curb pirating is that both Showtime and The Movie Channel will be scrambled for satellite transmission, probably by September of this year. M/A-Com Telecommunications Division, Germantown, Md., will supply its Videocipher II scrambling and descrambling products to cover the links. Videocipher II was first chosen to scramble Home Box Office [*ElectronicsWeek,* Sept. 24, 1984, p. 19].

Cable alternative

Enter DBS as an alternative way to receive TV by means of satellite—but not, however, with conventional NTSC video pictures. DBS operators, intent on providing a service that is in every way more appealing than cable distribution or terrestrial broadcasts, are considering new transmission schemes such as B-MAC, developed by Scientific-Atlanta Inc., Atlanta. The multiplexed analog components approach (Fig. 4) calls for time-multiplexing a luminance channel, a chrominance channel, and a data channel that carries program sound.

The chief advantage of B-MAC is that it allows for the cheap implementation of line-translation descrambling at the receiver. A maximum of three TV lines of storage—which can be implemented with charge-coupled devices—is needed for the descrambling and decoding function. What's more, the reconstructed picture contains none of the visible degradations that frequently mar scrambled and reconstructed NTSC video.

The MAC format can also provide direct-component red-green-blue video with a resulting improvement in picture quality for the viewer. Moreover, hopes run high that DBS satellites eventually will transmit two video channels per program channel for high-definition TV reception. But even with current plans, DBS brings closer the prospect of an integrated home entertainment-and-information system that surpasses the performance of terrestrial and cable technologies combined (Fig. 5).

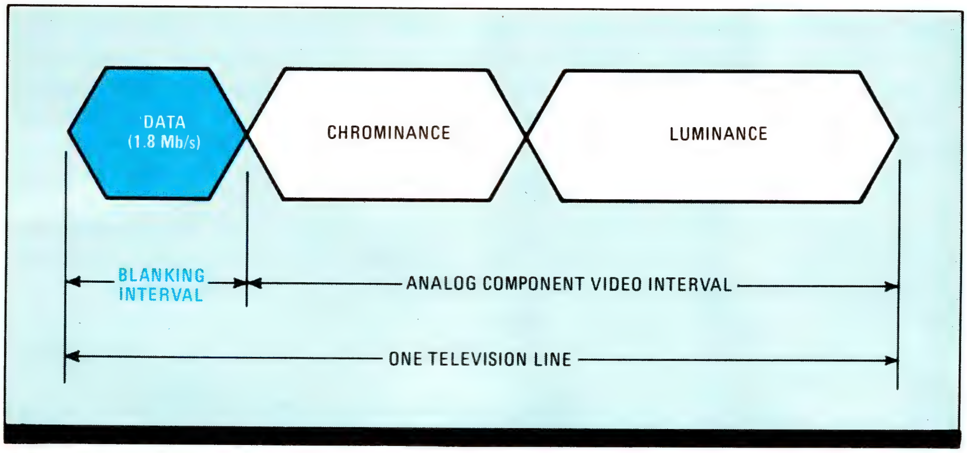
At a fixed carrier level, the signal-to-noise ratio achievable at the DBS delivery point depends chiefly on the noise temperature of the low-noise down converter (LNC) and on the antenna's polarization, pointing error, and gain. Other ways to enhance performance include the use of an offset-feed paraboloid geometry that reduces the LNC's signal blockage. Another advantage of this approach is that the dish may be placed on a more vertical angle, which can cut down on the accumulation of snow and ice.

Blockage of the LNC aside, antenna gain is directly related to the dish size. Hence to keep the dish small—for easy installation and to prevent damage to the roof structure, as well as for an unobtrusive appearance—the need to place high-power DBS transponders in orbit becomes imperative.

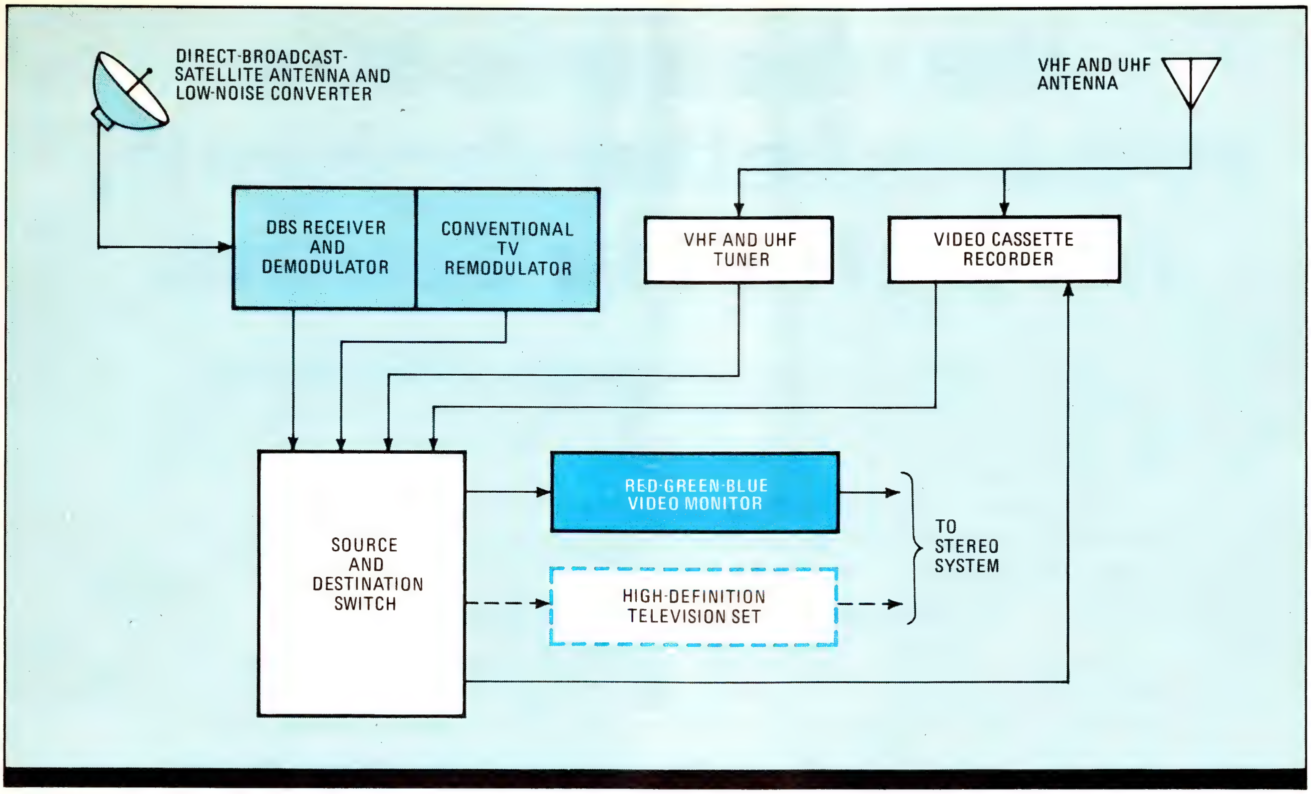
Smaller dishes

Satellite transponders with 200 W of transmission power allow the use of rooftop dishes 0.6 to 1.0 m in diameter, while conventional, lower-power transponders would require dishes of up to 1.8 m. Meeting this DBS challenge—and making possible dish sizes noticeably smaller than the C-band TVRO antennas, which measure at least 6 ft across—are advances in traveling-wave tube amplifiers for the 12.2- to 12.7-GHz band. One such TWTA, developed by Hughes Aircraft Co., Culver City, Calif., delivers 240 W of continuous-wave power, with an overall efficiency of 41% to 43%.

For a goal of seven years of operation in orbit, the TWTA employs focusing by temperature-compensated samarium-cobalt magnets, which helps to reduce the focusing deterioration that results from internal and external temperature effects. High-performance components of the TWTA include an M-type dispenser cathode, a beryllium oxide-supported tungsten helix, and a radiation-cooled collector.



4. Better picture. The multiplexed analog components scheme time-multiplexes the components of a direct-broadcast-satellite TV signal line by line. The 9-μs blanking interval is used for transmission of 1.8-Mb/s digital data such as descrambling keys, teletext, and personal addresses.


DIRECT-BROADCAST-SATELLITE ANTENNA AND LOW-NOISE CONVERTER
VHF AND UHF ANTENNA
DBS RECEIVER AND DEMODULATOR
CONVENTIONAL TV REMODULATOR
VHF AND UHF TUNER
VIDEO CASSETTE RECORDER
SOURCE AND DESTINATION SWITCH
RED-GREEN-BLUE VIDEO MONITOR
HIGH-DEFINITION TELEVISION SET
TO STEREO SYSTEM

5. Coming up. A home earth station consisting of a rooftop dish, a receiver-demodulator, and a remodulator for conversion to the conventional NTSC format, allows the selective use of red-green-blue monitors. DBS also may usher in the long-awaited capability for high-definition TV.

Further ahead in the future, DBS operators hope, there will be longer lived solid-state power amplifiers that will be able to replace TWTAs. Solid-state amplifiers do not experience the wear-out mechanisms of TWTAs, such as cathode depletion that can limit a satellite's life cycle. Solid-state power amps have been used at the lower C-band frequencies; however, individual high-power devices for the Ku band are not yet available. Current amplifiers operating at the higher frequencies are capable of a mere 3 W or so.

Array antennas

Large numbers of the lower-power Ku-band solid-state amps, however, can be assembled into an active array antenna to supply the required DBS transmission power. Ultimately, a DBS array antenna would have hundreds of low-power solid-state amps, one to drive each subarray. The combined radiation from all subarrays would form the desired downlink antenna pattern.

Each amplifier contains a phase shifter for maintaining the correct phase relationships between elements. Since the phase shifters can be adjusted after the satellite is placed in orbit, the radiation pattern of the active array antenna can be changed on demand.

RCA Laboratories is developing such an array antenna at its Microwave Technology Center, in Princeton, N.J. RCA is working with gallium arsenide FET amplifiers constructed with miniature beryllia circuit techniques.

The technological challenges in planning for the use of higher frequency bands are many, yet these problems can be overshadowed by political concerns. This is the case with Japan's opening up of its domestic markets to satellite communications [*ElectronicsWeek,* Jan. 1, 1985, p. 20]. The government initially called for the allocation of all satellite communications operation in the Ka band, and now it is up to the announced satellite ventures, with the participation of established U.S. satellite producers, to lobby for Ku-band use.

In Japan, too, researchers have their eye on placing satellite dishes on homes. But Japan's Ministry of Posts and Telecommunications is looking at frequencies much higher than even the Ka band for personal satellite earth stations, because the higher the frequency, the smaller the antenna needed.

The Japanese also are considering the capability for uplinking data from residences. The ministry has studied the feasibility of a 50-GHz uplink and 40-GHz downlink satellite system for communications among subscribers. The 64-kb/s data rate being considered is not suitable for carrying quality video programming, but general data services, voice, and image transmission—such as fax—are all on the list of services that the system would provide. A trial of the concept, possibly taking place early in the next decade, is one of the candidate missions under consideration for the Advanced Communications Technology Satellite for Experiments.

At the higher E-band frequencies, a rooftop dish only 30 cm in diameter is possible, at least in theory. One problem with the higher frequencies, however, is that attenuation during rainy weather becomes acute.

The rain problem is also experienced at Ku-band freqencies, but DBS planners in the U.S. have factored the worst-case fading losses into the existing link budgets. They expect to lick weather-aggravated attentuation with higher-power transponder amplifiers coupled with low-noise receiver components. ☐

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INDUSTRY'S VERDICT:

A GOOD YEAR AHEAD

CONNECTORS BOOST SYSTEM

When printed-circuit boards are packaged efficiently, the whole system benefits

☐ *by George Lawrence*

Digital electronics, especially when being used in microprocessor-based computers, requires efficient packaging to effectively handle a large number of printed-circuit boards. The means used to interconnect these boards must be carefully implemented, as connector options can affect the system's cost, efficiency, flexibility, and maintenance.

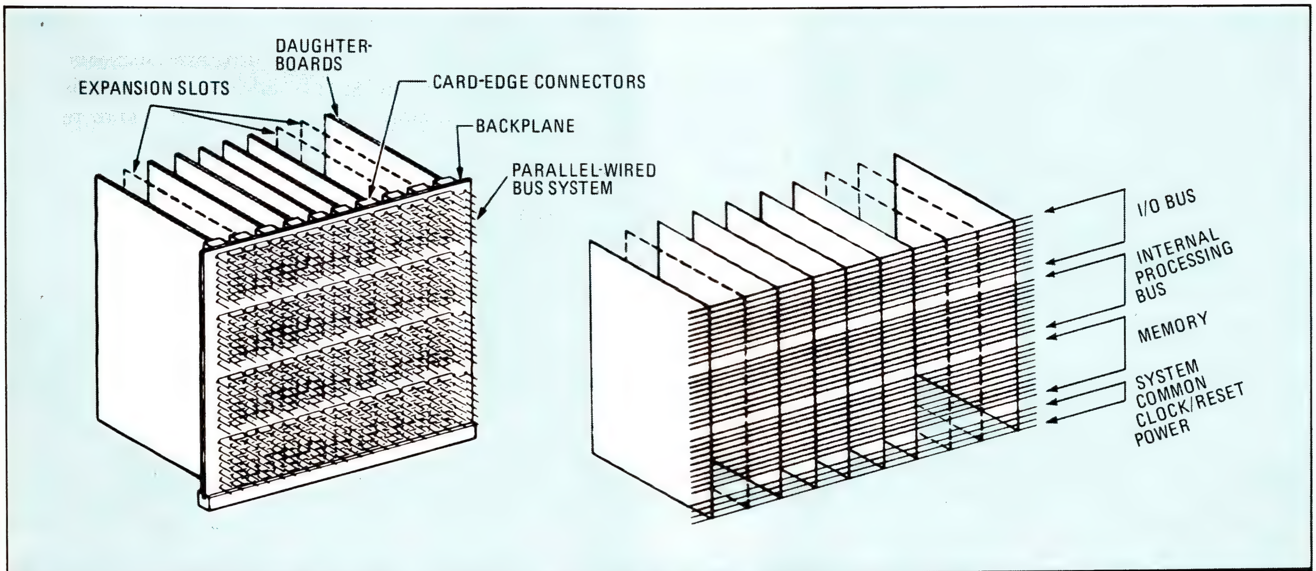
Microprocessor-based systems employ a series of buses containing signal lines for access to memory, internal processing, power distribution, and input/output. These signal lines provide orderly paths to carry most functions to each board in the system. Bus configuration affects packaging options and, conversely, packaging may affect the efficiency of the bus.

When selecting a packaging scheme, the first consideration is cost in terms of its effect on overall system costs. Also, bus lengths should be as nearly equal as possible, because unequal paths may produce unacceptable signal delays or distortion. As signal speeds become greater, path length becomes an increasingly important factor.

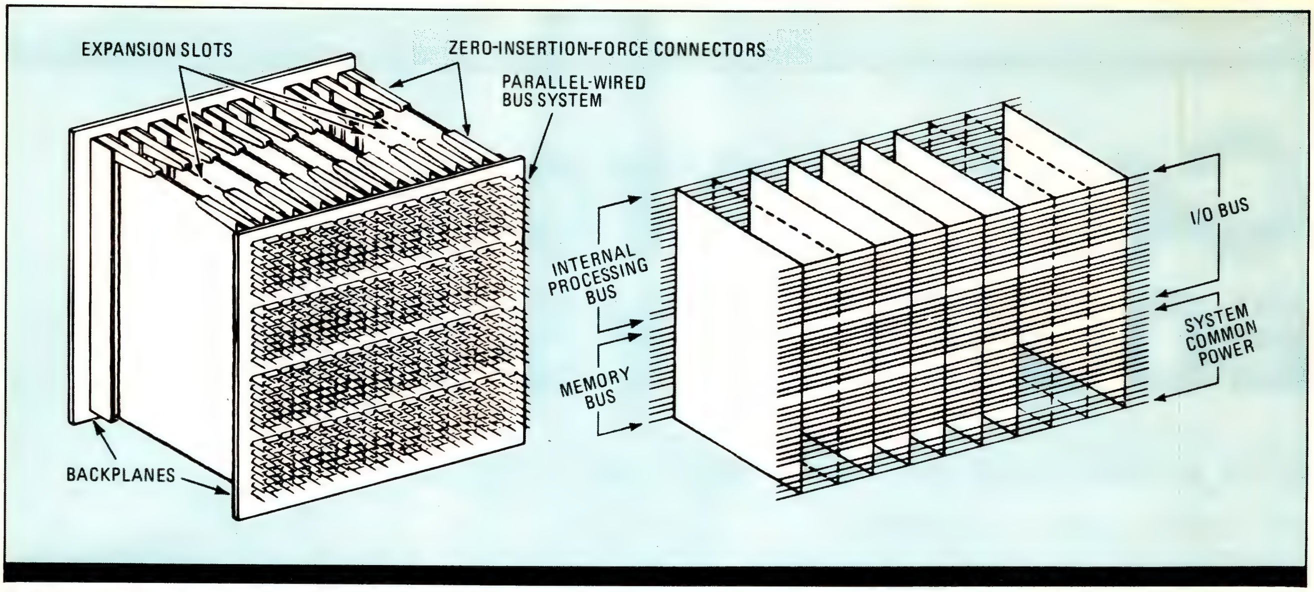
Bus parameters and packaging methods also affect a system's adaptability and expandability. With proper bus design, additional functions can be added to a system simply by adding boards to the bus. Further, systems can be upgraded easily by replacing an old board with a board built with newer technology. The ability to remove or add boards easily also simplifies maintenance as well as repair or replacement of a faulty board.

Bus selection criteria

Once the basic requirements are known, bus selection criteria must be developed. An important consideration in this process is the selection of connectors that interconnect the boards. As the number of board functions increases, the increased number of signal paths to and from each board makes proper connector selection critical. Also, the trend toward packing more electronics into less board space dictates the use of high-density connec-



1. Motherboards. In a backplane system, the motherboard that interconnects daughterboards may also contain electrical functions. Many personal computers have main system electronics on the motherboard; additional capabilities are on daughterboards.



2. Splitup. Split backplanes are used when the number of lines is too large for a standard backplane. Maintenance and repair are eased by specifying side-entry zero-insertion-force connectors. These eliminate the need to disassemble by serving as both connector and card guide.

tors that permit efficient use of board space. However, another approach being taken is the use of larger, more densely packed boards, which frequently results in an increased number of I/O lines.

In laying out the cards that make up the system, the designer may choose either a backplane or a stacking bus structure. Three basic connector types are available: card-edge, two-piece, and zero-insertion-force (ZIF). Each of these basic types allows variations that permit versatile, flexible packaging of systems.

The backplane system uses a motherboard bus to provide a signal path between daughterboards (Fig. 1). Each daughterboard plugs into the motherboard and provides one or more of the specific electronic functions required for implementation of the system. In addition, the motherboard may also contain electronic functions. For example, many personal computers have the main system on the motherboard, while daughterboards provide additional system capabilities.

The standard, one-motherboard backplane-bus traditionally has employed one-piece edge connectors. However, two-piece connectors are now being used more often as electronic circuit complexity begins to tax the limits of traditional edge connectors. The tails of the connector may be soldered to the motherboard, or they may use a compliant pin. Compliant pins provide a reliable, gas-tight connection to plated-through holes on the board, thereby eliminating the need for more costly soldering.

Splitting up

If the number of signal lines required becomes unmanageable, the split backplane, which divides the bus between two motherboards, should be selected (Fig. 2). Using two backplanes shortens the signal-path length between the two daughterboards and thus improves electrical performance.

The obvious drawback to the split backplane with traditional card-edge connectors is that complete disassembly is required when replacing a single daughterboard. This problem is eliminated by using a side-entry ZIF connector. The ZIF connector contacts are cammed open so that the daughterboard slides into the connector; the connector serves as both a connector and a card guide, so that an individual daughterboard can be removed or replaced as required. Even though the ZIF connector may have a higher initial cost, this is offset by eliminating the need for guides and other hardware.

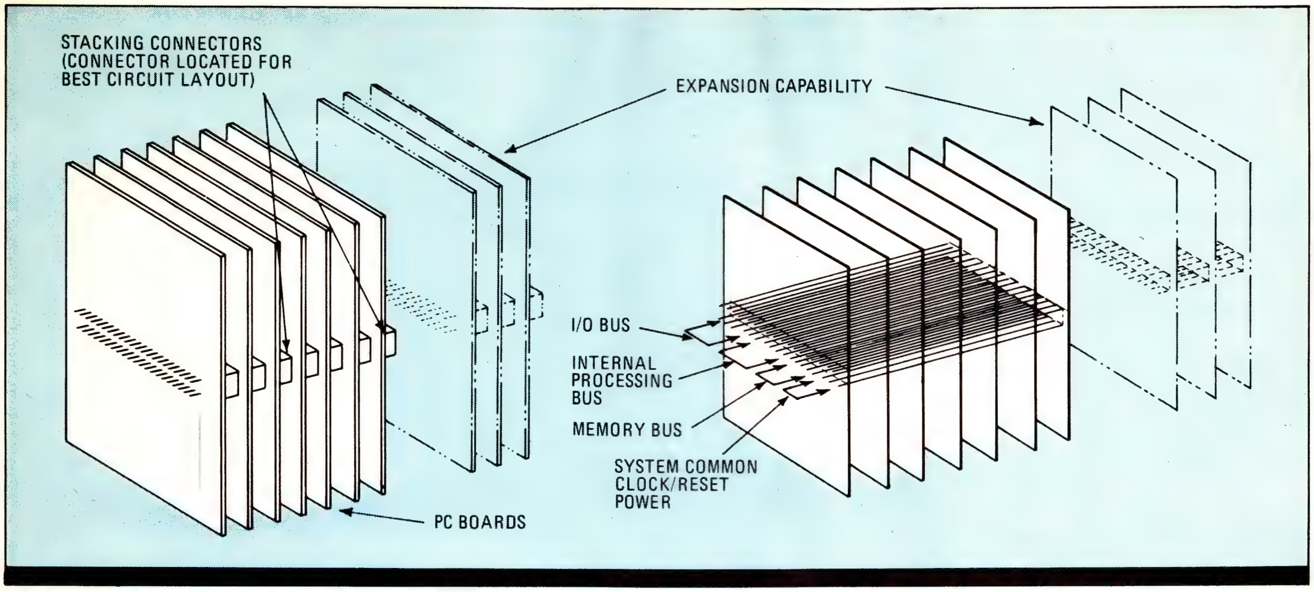
The backplane structure has the advantage of being widely accepted; it is a traditional, well-developed packaging scheme for which several standard bus configurations exist. Often, it is more cost effective to specify a standard backplane structure rather than to design a new one, and then use off-the-shelf daughterboards wherever possible. This minimizes the need to custom-tailor boards in the system.

Another advantage to the use of the backplane structure is the flexibility it affords. The motherboard can be designed to contain enough connectors to maximize system configurations; the system options may range from the minimum to maximum configurations. Because capabilities are expanded by simply adding new boards, the system is easily adapted for future needs, and repairs become just a matter of exchanging boards.

But the flexibility of the backplane may also be a disadvantage. Expansion capability is limited to the size of the motherboard and the number of connectors it can hold. In a minimum system, where many of the connectors remain unused, these connectors waste space and money. For example, a 10-slot motherboard that uses only two daughterboards is clearly inefficient. It may be difficult to find the proper balance between cost and the needs of both a minimal system and one that must be highly expandable.

The long signal paths in a standard backplane may limit the system's speed and performance. Designing the electronics to overcome the unequal delay times and resultant signal distortion will inevitably increase costs. The backplane structure is versatile and effective, however, and is still often chosen as the standard.

A stacking bus overcomes the backplane bus's disad-


STACKING CONNECTORS (CONNECTOR LOCATED FOR BEST CIRCUIT LAYOUT)
EXPANSION CAPABILITY
I/O BUS
INTERNAL PROCESSING BUS
MEMORY BUS
SYSTEM COMMON CLOCK/RESET POWER
PC BOARDS

3. Stacked. A stacking bus eliminates the motherboard while maintaining expansion capabilities. A minimum system contains no unused connectors and wiring. Maximum system size is limited by the cabinet's dimensions and by certain electrical considerations.

vantages by eliminating the motherboard, while continuing to maintain flexibility and expansion capabilities. The boards are stacked one next to the other, with the tails of each connector extending through one board and plugging into the connector on the adjacent board (Fig. 3). The bus is carried through the connectors from board to board. This reduces the limitations on the physical characteristics of the boards—any size, shape, and thickness can be used.

The stack's end boards automatically make expansion available. The minimum system leaves no connectors or wiring unused. The maximum system is limited only by the size of the cabinet and certain electrical considerations, such as the power supply's capability, limitations of the addressing method, and constraints imposed by the resulting delay times, among others.

In addition, the connectors can be placed anywhere on the board and a split bus is possible. Careful placement of the connectors will eliminate or reduce the need for other hardware to support the boards, and, of course, signals do not have to be brought to the edge of the board. The edges are then available for special interconnection needs. Because there is no motherboard, signal paths are shortened both on the board and through the connectors from board to board, resulting in improved electrical performance.

When it is necessary to remove or replace boards in the middle of the stack, however, some disassembly of the system may be required. Many stacking connectors require plated-through holes, which can add unnecessary complexity in some systems. Then, too, the stacking bus is less widely used and therefore is not standardized.

Connector options

Connector selection must be compatible with the bus structure while meeting definite cost and performance requirements. In selecting a connector, the following factors must be evaluated:

- The amount of gold required to plate the contacts. Some more expensive connectors save on other costs, such as a reduced need for gold plating and looser tolerances on the pc board. The initial price of the connectors is not the only criterion for selection.
- The mating force required to engage or disengage a non-ZIF connector, which imposes limits on the practical size of the connector, while the camming force limits the size of a ZIF connector.
- The center-line spacing between connector contacts, which controls the number of contacts per unit area. As the number of signal lines increases, higher density promotes efficient packaging.
- The choice of a mounting method, either solder contacts or press-fit contacts, where a reliable, gas-tight joint is made by a compliant pin.

Card-edge connectors are mounted on the motherboard, and pads on the daughterboard plug into the connector. But these connectors have disadvantages when the number of contacts required in the connector increases. To maintain electrical continuity over a wide range of board mechanical conditions, connector contacts must exert adequate force on the pc-board pads. With a large number of contacts this can translate into high insertion forces.

To provide sufficient contact force on the thinnest board and yet not permanently damage a thicker board, mating forces are usually held to between 8 and 16 oz per contact. These forces tend to limit the use of non-ZIF card-edge connectors to applications requiring 140 positions or less.

Warped or out-of-tolerance boards also affect insertion forces. Most card-edge connectors are designed for 0.062-in. boards, and typically are not used with thicker multilayer boards.

When considering packaging density, typical card-edge connectors are restricted to two rows of contacts to mate with two-sided boards. Card-edge ZIF connectors, such as used on the split backplane, reduce the mating force to zero when the connector is engaged or disengaged.

But again, the force required to cam the contacts

4. Double header. The disadvantages of conventional card-edge connectors can be overcome in many cases by using a two-piece connector. In this arrangement, half of the connector is on the board and the other half is on the backplane.

open limits the number of positions, and the connector still must compensate for board tolerances. Nevertheless, connectors of this type can accommodate up to 300 contacts without difficulty and should be considered when a large number of positions are required. The card-edge connector is still a good choice when the above conditions do not present disadvantages.

The two-piece connector (Fig. 4), where half the connector is on the daughterboard and half is on the motherboard, overcomes many of the disadvantages associated with the card-edge connector. Most versions use a 0.025-in. square pin and mating receptacle arrangement.

As a result of the receptacle design and the small tolerances involved, the mating forces for each contact pair are lowered, allowing more contacts per connector. Up to 700 contacts per connector are now possible. Without the limitation on the number of signals to and from the board, boards can handle very sophisticated functions.

The mating force per contact for five connector families from AMP Inc. varies widely. The highest force is 8 to 16 oz per contact for card-edge connectors, and the lowest is 0 for ZIF connectors. The other three families are all two-piece connectors. As the mating force drops, the maximum number of positions per connector increases. The exception is the ZIF connector, which in very high pin counts is limited by the force required to cam the contacts open.

The pin and receptacle arrangement can provide a large number of contacts per linear inch by allowing up to four rows of contacts per connector. Thanks to such efficient use of space, limitations on the system's layout and packaging are reduced.

Two-piece connectors sometimes cost more but may offer lower in-place and applied costs over card-edge connectors. Several factors should be considered in evaluating the cost of two-piece connectors.

Some cost savings can be realized in board manufacture when these connectors are used. For one thing, less board preparation—such as a beveled lead-in to aid insertion of the board into a card-edge connector—is required. For another, two-piece connectors do not require gold plating on the pc board.

Two-piece connectors provide reliable interconnection for several reasons. First, the receptacle contact can mate on two or even four sides of the male contact. Such multiple contact points provide a redundancy of electrical continuity and help make the connector relatively insensitive to vibration.

In addition, contacts are resistant to damage during mating and storage when protected by a plastic connector body that shrouds the contacts. Receptacle contacts are normally in cavities that protect them from stubbing during mating. Proper design of the connector housings ensures alignment of the contacts during mating. In addition, two-piece connectors can have special cavities that can be molded into the housing to accommodate power, coaxial, or fiber-optic contacts.

Both card-edge and two-piece connectors are predominantly used with backplanes. Boards can be stacked by using bottom- or top-entry receptacles in connectors. A special two-piece connector easily adaptable to a stacking bus is the stacking ZIF connector.

No one bus configuration and connector system is the correct choice for all applications. But the increase in electronic sophistication, density, and application requires design and packaging engineers to weigh available options carefully. The wrong choice can limit the system's design or make the design of future systems incompatible with existing systems.

As the number of I/O connections per board increases, the need for a flexible, high-density bus also increases. The selection of the bus affects the system's efficiency; similarly, selection of the connector affects the efficiency with which the bus is implemented. Connectors must be seen as more than hardware to be added after system design. They can significantly enhance or degrade the system. ☐

George Lawrence is senior development engineer at AMP Inc., Harrisburg, Pa.

CMOS ARRAY BREAKS 1 NS

Support for fast gate arrays comes in the form of an improved macrocell library and sophisticated CAD gear

☐ *by Steve Zollo*

Higher performance at lower cost is the come-on for National Semiconductor Corp.'s SCX6200 family of gate arrays. The CMOS arrays are available with 600, 1,800, 3,200, or 4,400 gates, and feature true 2-μm drawn geometry with 1.4-μm effective channel length. In addition, they make possible subnanosecond gate delays. For example, a two-input NAND gate carries a typical delay of 0.75 to 0.95 ns at 100°C junction, 4.5 V, and no load. The four new dual-metal, silicon gate arrays bring the total number of SCX6200 family members to seven, ranging from 600 to 6,000 gates.

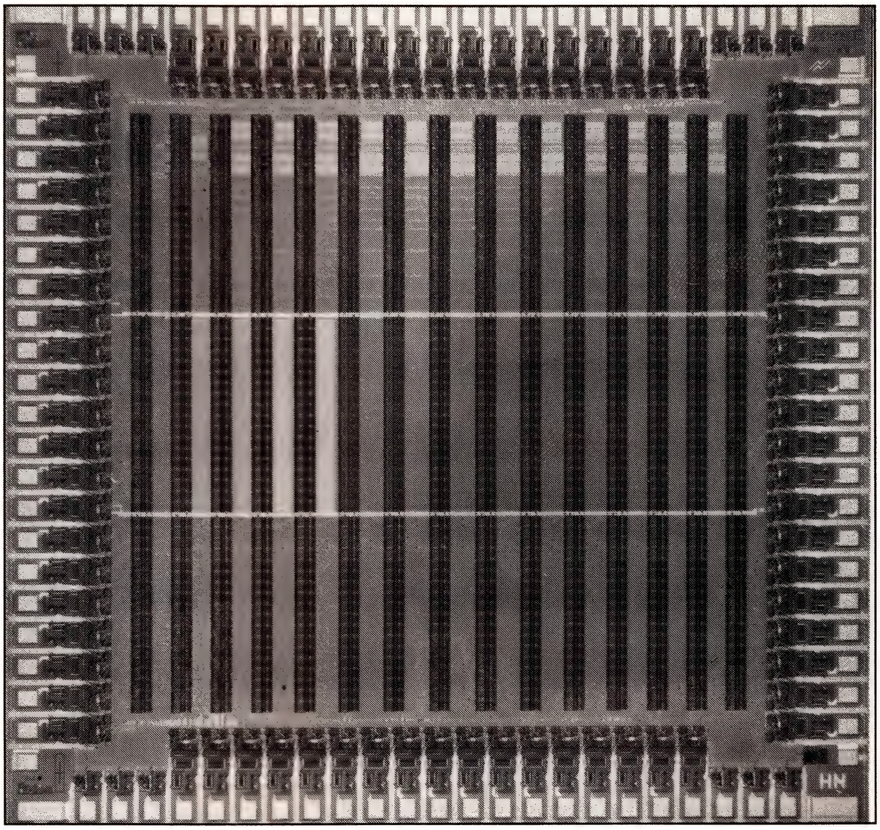
The new devices have enhanced input/output structures that perform multiple functions. Outputs are selectable for 1-, 2-, or 4-mA drive to allow TTL or CMOS compatibility. These allow the system designer to optimize the circuit's power consumption, noise immunity, and speed. Parallel buffering of I/O lines improves output drives while retaining the input pins.

In addition, the macrocell library has been improved to provide new features. For example, an expanded set of oscillator macros has been added, allowing output frequency capability of up to 45 MHz at 4 mA. The SCX6200 series of arrays features dedicated, multiplexed D flip-flops incorporated into the internal array core. These flip-flops are fully optimized to achieve significant system speed improvement while minimizing silicon utilization. This feature is ideal for scan-path design techniques as well as registers and counters, the company claims.

To make it easy for designers, the SCX6200 gate arrays are supported by a common set of design-automation tools compatible throughout the product family (with the exception of the 6,000-gate part, which has a unique architecture and macrocell library).

Design starts with a full complement of hardware macrocells, the basic building blocks from which users can select functions to implement their logic. From these building blocks come an ever-increasing selection of software macros including hardware macrocells prearranged and verified for 7400-series logic implementation.

All the design macrocells operate on a fully integrated computer-aided design system that performs schematic entry, logic simulation, timing verification, fault grading, and auto-place-and-route functions at up to 90% gate utilization. The AS/9000, National's IBM Corp. 370-



compatible computer, serves as the host.

The automated-design capabilities, specifically the front-end design functions such as schematic capture, net-list entry, logic simulation, and timing estimation are also available on the Daisy and Mentor Graphics work stations. These capabilities will be extended to such other popular CAD design stations as Valid Logic, CAE Systems, and the IBM Personal Computer, National says.

To allow work station users to interface properly with the SCX6200 gate arrays, National provides a software-design kit that consists of a set of floppy disks containing the logic symbols of all the macros, a net-list extractor, and model-timing data for pre-layout simulation and timing estimation.

A wide range of packages is available for finished products, including plastic and ceramic dual in-line packages, plastic and ceramic leaded chip carriers, ceramic leadless chip carriers, and ceramic pin-grid arrays. Test samples are available now; full-scale production will take place at National's new 6-in.-wafer fabrication facility in Arlington, Texas. Prices will be about 1¢ per gate in lots of 5,000.

National Semiconductor Corp., 2900 Semiconductor Dr., Santa Clara, Calif. 95051. Phone (408) 721-5113 [Circle reader service number 338]

Station designs boards and ICs, links to other systems

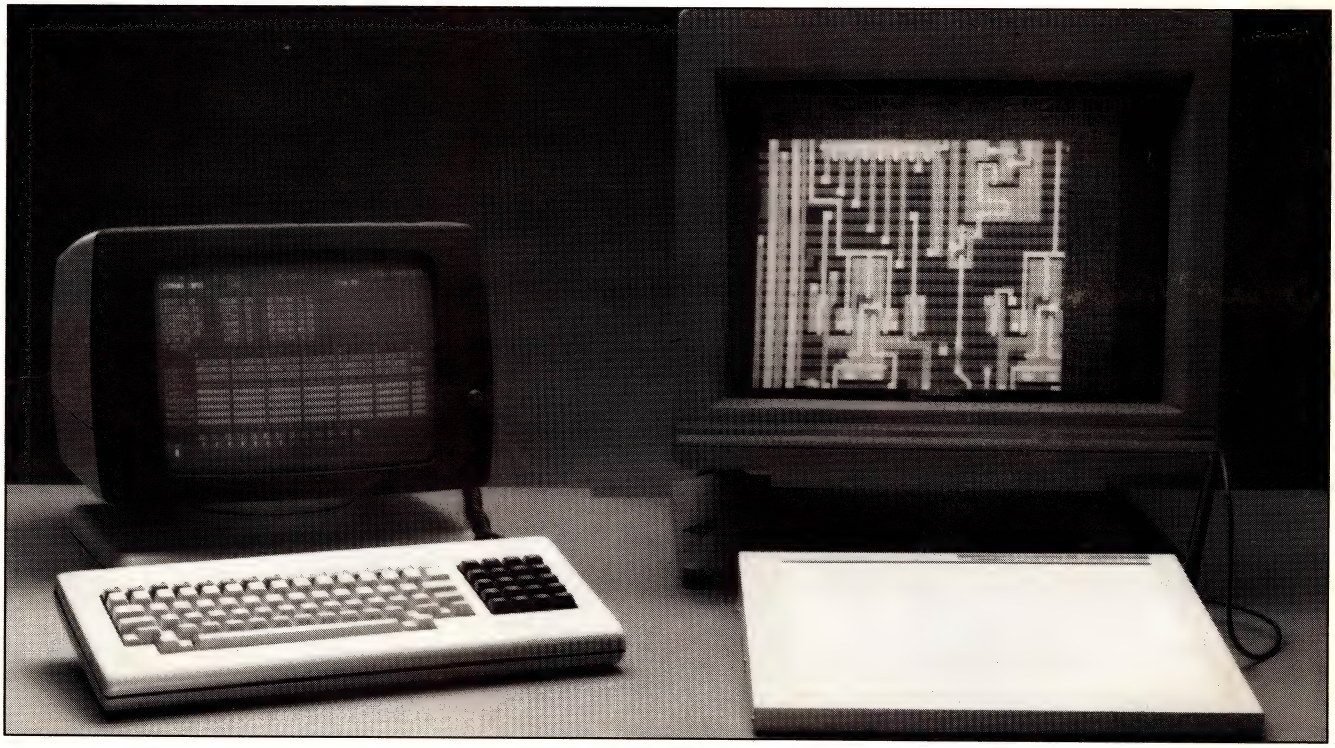
As integrated circuits and the boards on which they are placed get more and more complex, everyone involved with their engineering and design will need powerful work stations that are part of an integrated system for end-to-end computer-aided engineering, design, and manufacturing. Many design-automation companies are working toward building such systems. General Electric Co.'s subsidiary Calma Co. has just announced the next building block in its end-to-end system for electronics-design automation.

The new product is a powerful desktop work station, called the GDSII/32, for the layout of large, complex integrated circuits and printed-circuit boards. The GDSII/32, powered by a Data General DS/4200 32-bit central processor, puts a CAD station on an engineer's desk for $95,000 including the Graphics Design System II software and a network link to the rest of the Calma system. This is about $50,000 less than the big 16-bit minicomputer-based GDSII systems currently available.

The new work station, however, is completely compatible with the present GDSII system—design engineers do not need to learn a new way of designing. When connected to the larger systems, the GDSII/32 helps a designer do interactive circuit layout, called a foreground operation, with the desktop station and then access the main system for the more computation-intensive background operations such as design-rule checking and mask-pattern generation.

In addition to the 32-bit DS/4200 central processing unit, a GDSII/32 work station comes with a 1,024-by-1,280-pixel, 60-Hz noninterlaced color monitor, 2 megabytes of main memory, two 105-megabyte 5¼-in. Winchester disk drives, a hardware floating-point processor, and a software package called Chips.

Chips is a two-dimensional graphics system for designing ICs and pc boards. It includes the CustomPlus application package for symbolic, hierarchical IC design in all very large-scale integration technologies, including CMOS, n-MOS, and p-MOS. It automates all the design



rules, spacing, and compaction functions. Cards II, also included, is a design package for pc boards including hybrids and surface-mounting technologies.

The GDSII/32 work stations are available now with shipments 60 days after ordering. In keeping with its new emphasis on electronics-design automation, Calma will soon be enhancing the new low-cost work station with background job software to make it more of a standalone CAD station, says Robert F. Kuhling Jr., newly appointed vice president of Electronics Design Automation Products and Marketing.

Calma Co., 2901 Tasman Drive, Santa Clara, Calif. 95050
Phone (408) 748-9600 [Circle 382]

With plug-in board, IBM PC does logic analysis

With the PA32/20, the IBM Corp. Personal Computer becomes a powerful and efficient logic analyzer for under $1,500. The PA32/20 features symbolic trigger setup, timing diagram display, and a symbolic assembly-language display that is organized like an assembly-language print listing.

The software makes it possible to load symbol tables from a symbol-table file, a link map, a print file, or a combination of these. The software also makes it possible to save trace data and disk setups and to print the actual screen display.

The integrated software offers help commands in all interactive modes and, because it is compatible with WordStar, allows displayed data to be saved and later merged with other text. The analyzer features 32 channels at 20 MHz. Assembly-language display is available for the Z80, 6502, 8085, 8086, and 8088. Assembly-language display for one central processing unit and the high-speed parallel interface to the computer are included in the base price.

MonTex Microsystems, P.O. Box 1845, Huntsville, Ala. 35807.
Phone (205) 723-2927 [Circle 344]

Peripheral makes computer a 500-kHz oscilloscope

A peripheral that simply plugs into either an IBM Corp. Personal Computer, Apple computer, or Commodore computer converts its host into an easy-to-use digital oscilloscope. The peripheral and its accompanying software provide the oscilloscope functions, while the computer provides the intelligent control and analysis capabilities.

The peripheral is a four-channel digital scope with a 2-MHz sampling rate, 500-kHz analog bandwidth, and diode protection on all inputs. The graphics display uses up to 138 by 288 pixels for data display (up to four traces) and four lines of text for initial (default) values of the scope's parameters.

A menu-driven operating mode provides keyboard control of gain parameters for channels A, B, C, and D, time base values, number of channels, and trigger mode. All the postprocessing capabilities of the personal computer are available to store and retrieve waveforms from disk and to analyze and process the information.

The digital-oscilloscope peripheral for the IBM PC and PC/XT and Apple II, IIc, and IIe computers is priced at $499; for the Commodore 64 and SX-64, it sells for $399.

Rapid Systems Inc., 5415 136th Place S.E., Bellevue, Wash. 98006. Phone (206) 641-2141 [Circle 342]

Board lets IBM PC control instruments

Built around the Texas Instruments TMS9914A microprocessor, an IEEE-488 interface for the IBM Corp. Personal Computer and its compatibles can perform as a talker, listener, or controller. The PC4311 board provides the user with the option of communicating with the IEEE-488 bus under either programmed input/output, interrupts, or direct-memory-access control.

An on-board light-emitting-diode display indicates the state of the IEEE-488 control lines. A software package, supplied free of charge with the board, features three levels of use: a menu-driven configuration, linkable assembly-language subroutines, and an installable device driver.

The first option allows first-time users to familiarize themselves with the card and the IEEE-488 interface, while the second level allows easy integration into existing application-specific software. The third level enables the user to integrate the PC4311 into the computer and use the card with a minimum amount of effort. Available from stock, the PC4311 is priced at $420.

Applied Micro Technology Inc., P.O. Box 3042, Tucson, Ariz. 85702. Phone (602) 622-8605 [Circle 343]

Development system eases use of SSI 263 speech chip

Engineers working with the SSI 263 CMOS speech-synthesizer chip will have an easier time, thanks to a development system that automates the process. The system comprises a Z80- and SSI 263-based circuit board, a software disk, a sample vocabulary data disk, and a 150-page manual that covers the operation of the SDL as well as phoneme-based speech structure and theory.

The system's SSI 263 synthesizer contains five 8-bit registers that allow software control of speech rate, pitch-movement rate, amplitude, articulation rate, vocal-tract filter response, and phoneme selection and duration. Phonemes may be entered, edited, and modified, allowing all of the SSI 263's complex features to be rapidly auditioned and adjusted for maximum intelligibility.

An audio word processor, the SDL offers disk storage, recovery, and merging of speech data, with file management, eight complete on-screen buffers, and a user-programmable macrophoneme capability. Priced at $749, the SDL is available from stock.

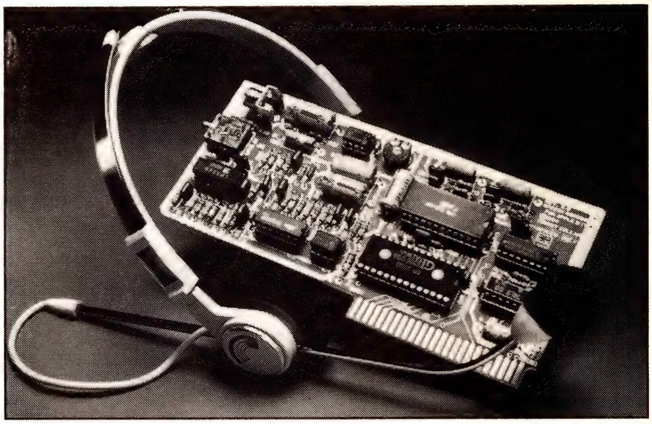
BLB/Microtel Inc., 8397 Melrose Dr., Lenexa, Kan. 66214. Phone (913) 492-7707 [Circle 348]

Board gives computer talking and listening capabilities

Using the SP1000 LPC voice-recognition chip, the Lis'ner 1000 is both a voice-recognition and speech-synthesizer board that fits in both the Apple II and Commodore 64 computers. It can also be used with other 6502-based systems.

The Lis'ner 1000 is designed for speaker-dependent unconnected-speech applications. The board functions as a parallel voice-entry device to the keyboard and is transparent to the operation of the computer.

When Lis'ner 1000 hears a word it recognizes, it sends a preprogrammed sequence of characters to the keyboard input handler as if it had been typed. In addition to speech recognition, the board is capable of speech output from a precoded (linear predictive coding) word dictionary. The Lis'ner for Apple computers optionally accommodates an SSI 263 phonetic speech synthesizer chip with a text-to-speech algorithm.



A board for Commodore 64 computers sells for $149; the board for the Apple computers is priced at $189. With the SSI 263 chip, the board goes for $259. All versions are available now.

Micromint Inc., 561 Willow Ave., Cedarhurst, N.Y. 11516. Phone (516) 374-6793 [Circle 347]

Converter delivers tracking rates of 8 revolutions/s

A 16-bit synchro/resolver-to-digital converter delivers minimum tracking rates of 8 revolutions per second, more than double the previously available rate of 3 revolutions/s. The converter is useful in military position-control applications; it is also useful when synchro or resolver angular information has to be converted into a high-resolution digital format.

The SDC/RDC1711's output represents absolute position and automatically tracks the synchro or resolver shaft without convert commands or status-wait loops. Latched three-state outputs provide easy interfacing with both 8- or 16-bit data buses, enabling data transfer without disturbing the tracking action of the converter.

The converter has a resolution of 19.8 arc-seconds and overall accuracy of ±1.3 arc-minutes over temperature. It offers a step response of 250 ms at a maximum and a wide signal and reference-frequency range from 360 Hz to 2.6 kHz. In lots of 25 to 99 pieces, the converter is priced at $518. Delivery takes six to nine weeks.

Analog Devices Inc., Rte. 1 Industrial Park, P.O. Box 280, Norwood, Mass. 02062. Phone (617) 329-4700 [Circle 380]

Amplifier and converter team up in systems

Designed to be partners in systems, a track-and-hold amplifier and an analog-to-digital converter work together to build systems with high speed and highly accurate outputs. The hybrid THA-05203 track-and-hold amplifier features 150-ns acquisition time to within 0.01% for a 10-V step. Linearity is held to within 0.005%. Housed in a 24-pin dual in-line package, the THA-05203 measures 1.4 by 0.8 by 0.2 in. and weighs 0.4 oz. The hybrid operates over a temperature range from –55° to +125°C.

The ADC-00403 is a 12-bit 2-μs hybrid ADC that features ±0.012% linearity error. Packaged in a 32-pin hermetically sealed dual in-line package, the ADC-00403 measures 1.14 by 1.93 by 0.2 in. and weighs 0.67 oz.

The pair of units, which is targeted at military and industrial data-conversion needs, is priced at $425 in lots of one to nine pieces. Delivery takes about 12 weeks.

ILC Data Device Corp., 105 Wilbur Place,
Bohemia, N.Y. 11716.
Phone (516) 567-5600 [Circle 354]

Hybrid converter keeps system costs low

Compared with typical voltage-to-frequency converter systems assembled from a variety of monolithic components, the model 3815—a hybrid voltage-to-frequency converter—provides much better performance, the ease of working with a single unit, less space consumption, and lower costs. The 10-kHz 3815, which is housed in a 14-pin dual in-line package, can be operated from either a ±15-V supply or a +15-V supply.

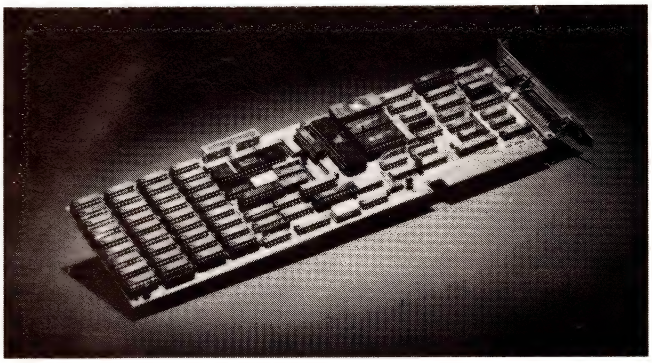
The hybrid can be operated in either voltage-to-frequency or frequency-to-voltage modes; linearity is held to within 0.005%, according to the company. In lots of 100 pieces, the 3815 sells for $19 each. Higher-frequency versions, at 25 kHz and 100 kHz, are also available. Delivery takes about two weeks after receipt of order.

Dynamic Measurements Corp., 8 Lowell Ave., Winchester, Mass. 01890.
Phone (617) 729-7870 [Circle 353]

Two-board set builds IBM PC lookalike

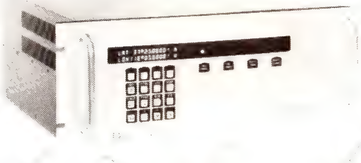
A two-board set allows original-equipment manufacturers and systems integrators to build or enhance IBM Corp. Personal Computer-compatible products at low cost. The Qc1016 and Qc1017 meet the standard IBM expansion-board profile and are all that is required to complete the electronics for an IBM PC lookalike, including an adapter for floppy-disk drives, a monochrome display, and a parallel-printer interface.

The Qc1016 includes the processor based on a 4.7-MHz 8088, a specially designed basic input/output sys-



DATUM's Model 9390 GPS Time and Frequency Monitor

DATUM's 9390 provides a cost-effective means of synchronizing precision clocks and timing instruments to within better than 100 nanoseconds of GPS time. The unit employs C/A code transmissions from the GPS satellite constellation and produces corrected 1-pps and 1-ppm reference outputs.
Scheduled satellites are automatically acquired and tracked for time and frequency determination. Only one satellite is required when geographical coordinates of the antenna are known. Otherwise, positioning is performed by tracking four satellites.



Front panel controls are provided for manual control. Remote control and data transfer are accommodated by an RS232C I/O port.

Entirely self contained, the 9390 is supplied complete with antenna/preamp and cable. Several optional features are available.

DATUM also manufactures a comprehensive line of timing instrumentation, from individual displays to complete range timing systems.

For complete information or applications assistance, call or write today.

datum inc
TIMING DIVISION
1363 S. State College Blvd.
Anaheim, California 92806
(714) 533-6333

Circle 59 on reader service card

tem (BIOS) in read-only memory that is compatible with PC DOS 2.1 and 3.0, an on-board floppy-disk-drive adaptor, an asynchronous commmunications adaptor, a keyboard, a speaker, and reset ports. Additionally, the board supports both the CP/M and Concurrent CP/M operating systems.

The second board, the Qc1017 (pictured), allows for memory expansion up to 256-K bytes with parity. It has on-board IBM-compatible adaptors for a monochrome display and parallel printer interface, plus another asynchronous communications adaptor.

The company claims that these two boards provide all of the functions of the IBM PC on a motherboard and four expansion boards. Prices to OEMs are $295 for the Qc1016 and $375 for the Qc1017. Volume delivery is from stock.

Quam Corp., 900 W. 128th St., Suite 208, Burnsville, Minn. 55337.
Phone (612) 894-2360 [Circle 350]

Board adds communications ports to IBM PCs

Installable in any full-length expansion slot of an IBM Corp. Personal Computer, PC/XT, or PC AT, the Octacom adds from four to eight serial ports. With the module, a IBM PC can tie into modem phone lines, monitor fire alarms and security systems, connect remote terminals for data entry, and commmunicate with mainframes or peripheral serial devices such as plotters and printers.

Designed for use with the new IBM PC Xenix or several other multiuser, multitasking operating systems, Octacom can also be used with PC-DOS in many applications, including Basic programs (if the Octadrive device driver is also installed).

Octacom contains separate 8250 UARTs, which perform serial-to-parallel and parallel-to-serial conversion, data checking, parity generation, and baud-rate generation. Each UART may have its own baud rate, parity, number of bits per character, and stop bits individually programmed. Baud rates stretch from 50 baud to 10.2 kilobaud.

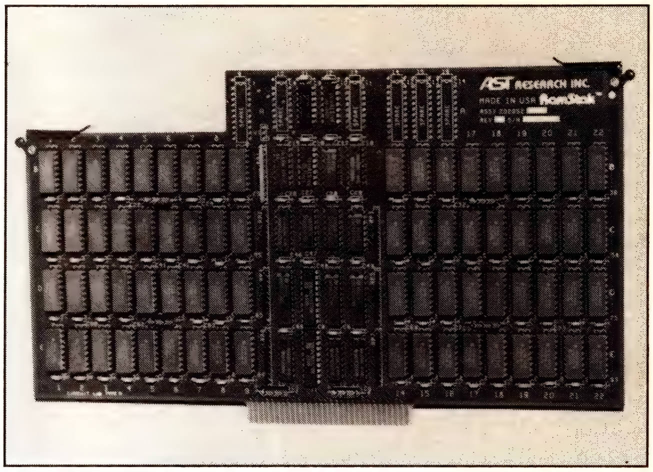
A four-channel Octacom card sells for $295; an eight-channel version goes for $395. Octadrive software is $25. The boards are available now.

Star Gate Technologies, P.O. Box 764, Cleveland, Ohio 44026.
Phone (216) 292-5390 [Circle 352]

More memory gives Lisa the smarts

A single-slot memory-expansion board supports 256-K dynamic random-access memory chips to provide up to 2 megabytes of RAM to Apple Computer's Lisa. With the RamStak installed, users can take advantage of Lisa's full 2-megabyte addressing capability.

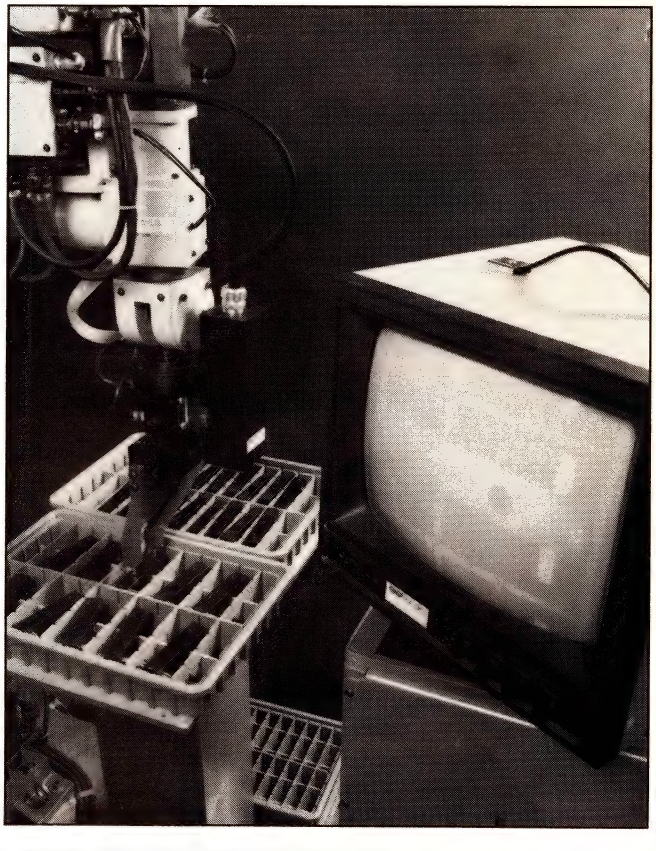
Designed to occupy one of the two expansion-board slots provided within the Lisa enclosure, the RamStak offers several configuration options: 512-K bytes, or 1, 1.5, or 2 megabytes. Memory-expansion kits for upgrading the minimum configured product in 512-K-byte increments will also be available. Available now for immediate delivery, the RamStak is priced at $1,395. Expansion kits start at $1,000.



AST Research Inc., 2121 Alton Ave., Irvine, Calif. 92714.
Phone (714) 476-3868 [Circle 351]

Vision system detects 256 shades of gray

For robotics applications where the lighting level is low or little contrast exists, a vision system with true gray-scale processing can do the trick. The V-200's ability to perform true gray-scale processing distinguishes between 256 shades of gray to enable it to perform a variety of



tasks. It operates as an assembly cell or as a stand-alone unit. Built around a 68000-based computer, the V-200 can transform a gray-scale image in less than 20 ms. Its array processor can perform up to 40 million operations/s, and the parts recognition rate is up to 1,200 parts/min. The V-200 can accept four RS-170 camera input lines, and it will put out the image to one monitor.

Programming is done in Pascal, and instructions are menu-driven. The manufacturer will quote a price and shipping time, depending on customer requirements.

GMF Robotics Corp., Northfield Hills Corporate Center, 5600 New King St., Troy, Mich. 48098 [Circle 355]

System tests 300-mil DRAMs at eight test sites

A multitest-site environmental handler, the System 380 Octal, provides parallel testing of 300-mil dynamic random-access memories independently, at two banks of four test sites each. If desired, each bank can operate independently of the other. The continuous-input belt can accommodate 22 sleeves and is loaded at the operator's shoulder level. The input belt can be ordered with or without a device inverter.

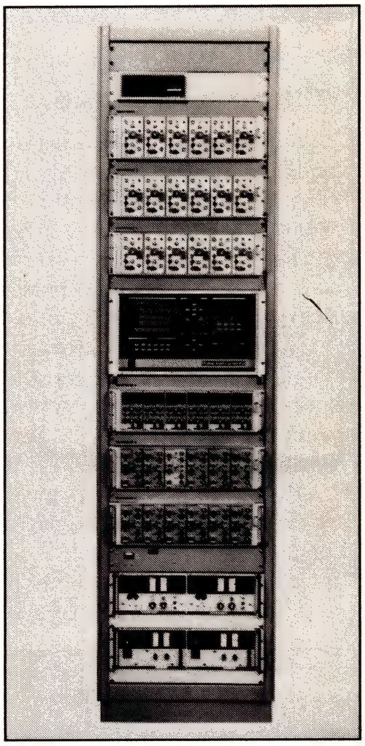
The System 380 Octal operates over a temperature range of –55° to +150°C. Soak time is programmable, and the temperature guardband allows a settable ±2°C to ±30°C temperature-deviation inhibit. Totally enclosed within a controlled thermal environment, the test site provides temperature accuracy to ±1°C. A IEEE-488 bus interfaces the system to a test controller, and interface hardware is available for all major testers.

The manufacturer will quote price and delivery time for the System 380 Octal, depending upon configuration.

Sym-Tek Systems Inc., 3912 Calle Fortunada, San Diego, Calif. 92123. Phone (619) 569-6800 [Circle 365]

CCD test system operates at 50 MHz

The 9000 series charged-coupled-device test system, capable of both static and dynamic testing, derives its speed of 50 MHz from the PI-5800 data generator, which provides from 16 to 256 data-pattern channels with a memory depth of 4-K per channel. Low noise operation—less than 500 μV peak-to-peak—is achieved by employing rack-mounted, integral dc to power each of the voltage-source, digital voltmeter, and pulse-driver modules; no power transformers are used in any of these modules.



A variety of test modules may be tailored to the application by using either a single- or a dual-rack arrangement. An optional scanner is also available for reading driver output amplitude and bias supply voltage.

The price of a CCD test system varies with the configuration desired. Delivery is in 12 to 16 weeks.

Pulse Instruments Co., 1234 Francisco St., Torrance, Calif. 90502. Phone (213) 515-5330 [Circle 364]

Fiber-optic test system built from modules

A rack-mounted bin with power supply and controller is at the heart of a modular, multichannel, fiber-optic test system. Into this bin, the user can insert various combinations of eight channel sources and power monitors. The system then interfaces to a computer, where an internal multiplexer allows the sampling of various channels. In large-channel-count systems, each eight-channel module can be given a unique address, and the controlling computer can sample each module individually.

Sources—light-emitting diodes or lasers—are available in all popular wavelengths and with interfaces for most fiber and connector types. Couplers split the power for multiple outputs, and optical feedback is used to stabilize output power. Connector or splice loss can be measured on this test system to within 0.1 dB. Options include silicon or germanium detectors for short- or long-wavelength measurements, respectively.

Gain can be selected to fit the application. These test systems are said by the manufacturer to be compatible with many data-acquisition systems, including those configured around the IBM Corp. Personal Computer.

Cost of the system and delivery time depends upon the options chosen. The manufacturer will supply price quotations.

Fotec Inc., 560 Harrison Ave., Boston, Mass. 02118.
Phone (617) 542-1719 [Circle 363]

Six-axis robot can spray-coat, grit-blast

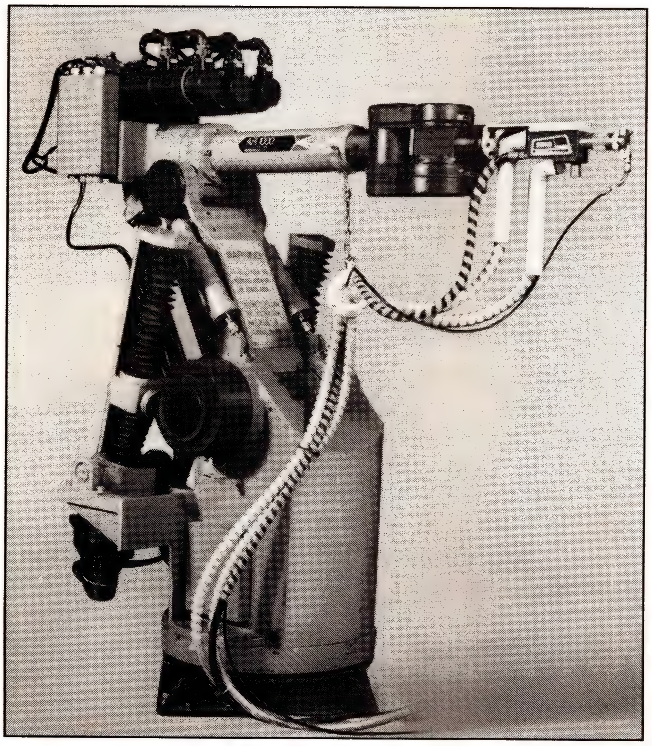
A computer-controlled, six-axis, articulated-arm robot is designed for thermal spray-coating or grit-blasting operations. The AR 1000 robot has a waist, shoulder, and wrist design that accurately maintains spray distance and precisely controls the traverse speed over an almost infinite number of geometric part configurations, according to the manufacturer.

The robot's arm also enables very fast directional changes, with an acceleration or deceleration time (ramp speed) of 350 ms. The robot can be programmed either point to point using a teaching pendant or off line through a keyboard and monitor. The robot can store up to 40 programs in permanent memory.

The AR 1000 robot consists of six major components including the robot body, controller, operating module, interface module, teaching pendant, and keyboard and monitor unit. The controller, which stores the programs and has 128-K bytes of memory, can handle up to 1,000 point locations in space (the average thermal-spray program requires about 15). The company provides 10 standard software programs with the unit, covering common part configurations.

Pricing for the AR 1000 was unavailable at press time.

Metco Inc., 1101 Prospect Ave., Westbury, N.Y. 11590.
Phone (516) 334-1300 [Circle 349]



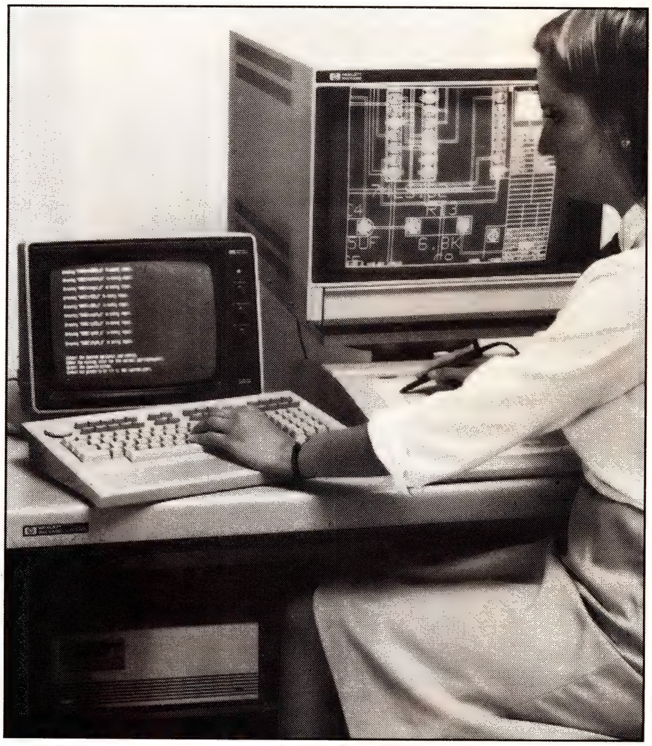
Graphics system offers multiple drawing levels

Schematic entry, printed-circuit-board artwork, two-dimensional mechanical drafting, and general-purpose drawing are available on an advanced version of Engineering Graphics System, which runs on HP 9000 series 200 work stations. When used in the pc-board mode, the manufacturer says that EGS can provide postprocessors for photoplotter and numerical-control drill-machine outputs, plus data-file transfer to the HP 3065 board-test system.

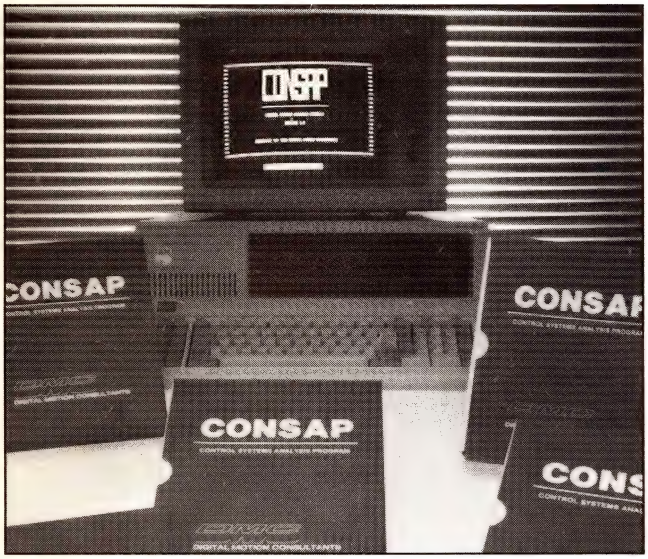
Bidirectional initial-graphics-exchange-specification (IGES) translators are available, permitting drawings from EGS to be transported to and from other manufacturers' IGES-supported computer-aided-design systems. A variety of the manufacturer's plotters can be added to the system.

EGS alone is priced at $10,000, and delivery takes 8 weeks. A typical system, consisting of an HP 9000 series 200 Pascal 3.0 work station with a 1.7-megabyte memory and a 15-megabyte disk drive, is priced between $25,000 and $40,000 depending on user options.

Hewlett-Packard Co., Inquiries Manager, 1820 Embarcadero Rd.,
Palo Alto, Calif. 94303. [Circle 358]



Control-systems software is offered for IBM PC



Consap, an integrated software package designed to run on the IBM Corp. Personal Computer or a compatible running under PC-DOS, offers features for the design of both analog and digital control systems. With Consap, the designer can define the systems elements, combine them, perform steady-state error analysis and stability analysis, and compute the system's time response. Analysis can be performed on both continuous and discrete-time systems, and Consap will automatically design both analog and digital filters to compensate the system to the designer's specifications.

The Consap software package is available now, at a price of $1,495.

Integrated Motion Systems Inc., 3460 S. Broadway, Englewood, Colo. 80110. Phone (303) 762-1817 [Circle 359]

Thermal-data software runs on 48-K-byte Apple II

A program that can handle up to 64 input channels, Tempsense software is designed to be used with a 48-K-byte Apple II+ or Apple IIe equipped with an Adalab interface card and from one to eight 8-channel Ada-MUX input multiplexers. Data signals can be handled from any of the seven common thermocouple types, and Tempsense can also calibrate and read integrated circuit-type temperature transducers. When very low-level signals are read, an Ada-amp instrumentation amplifier must be used.

Data values are displayed on either Celsius or Fahrenheit scales, and acquired data is automatically stored on disk in batch files.

Tempsense software is priced at $100; a complete 8-channel system that includes an Apple IIe computer costs $2,455. Tempsense is available now.

Interactive Microware Inc., P.O. Box 139, State College, Pa. 16804. Phone (814) 238-8294 [Circle 357]

Hybrid has two multiplexers and a sample-and-hold amp

Based on a proprietary hybrid-circuit design, the HS362 S/B guarantees a 6-mV sample-to-hold step and 600-ns hold-mode settling time. The sample-and-hold amplifier is packaged with two eight-channel multiplexers in a single 32-pin ceramic package that operates in the temperature range of –55° to +125°C and is screened to MIL-STD 883B.

The HS362 S/B features 12-bit precision and 7-μs acquisition time to 0.01%. An internal user-controlled switch connects the multiplexers in either a single-ended or a differential mode. An output buffer connects directly to the unbuffered analog input of most 12-bit, successive-approximation-type analog-to-digital converters; used in conjunction with a 12-bit ADC, it is possible to create a complete 8- or 16-channel data-acquisition system.

The maximum droop rate of the HS362 S/B is 1 mV/ms, and the circuit operates from ±15 V and ±5 V with a total power dissipation of 700 mW. It is available now, and sells for $308 in 100-unit quantities.

Hybrid Systems Corp., 22 Linnell Circle, Suburban Industrial Park, Billerica, Mass. 01821. Phone (617) 667-8700 [Circle 372]

Modular image systems have multiple resolutions

A pair of high-resolution imaging systems, the models 6500 and 6700, features modular architectures that let them be configured to serve such varied applications as industrial, military, and resource analysis.

The model 6500 provides 1,280-by-1,024-bit image processing (30 Hz interlaced) and display using 8- or 12-bit

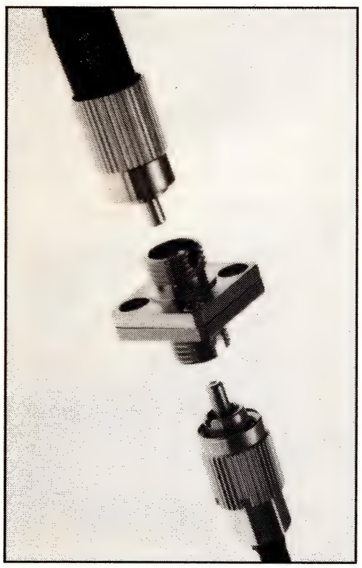
images. It will also operate as a 640-by-512-bit (60 Hz noninterlaced) display supporting true color, pseudocolor, or up to three simultaneously displayed monochrome images. Up to 10 independent graphics planes are capable of independent zoom and scroll through 16× enlargement, with respect to both the images and each other.

The 6700 is a monochrome or pseudocolor image processor with a 1,024-by-1,024 bit display using 8-, 12-, or 16-bit imagery. A fully configured system has up to eight image memories. Image memories can also be configured in 512-by-512-bit resolution, and up to 24 graphics planes at 1,024 by 1,024 by 1 bit each are available.

For end users, the 6500 sells for $39,000 and up, while the 6700 starts at $49,000. Discounts for original-equipment manufacturers and volume orders are available. Deliveries of both models are scheduled during the first quarter of this year.

International Imaging Systems, 1500 Buckeye Dr., Milpitas, Calif. 95035. Phone (408) 262-4444 [Circle 379]

Single-mode connector installs with three parts



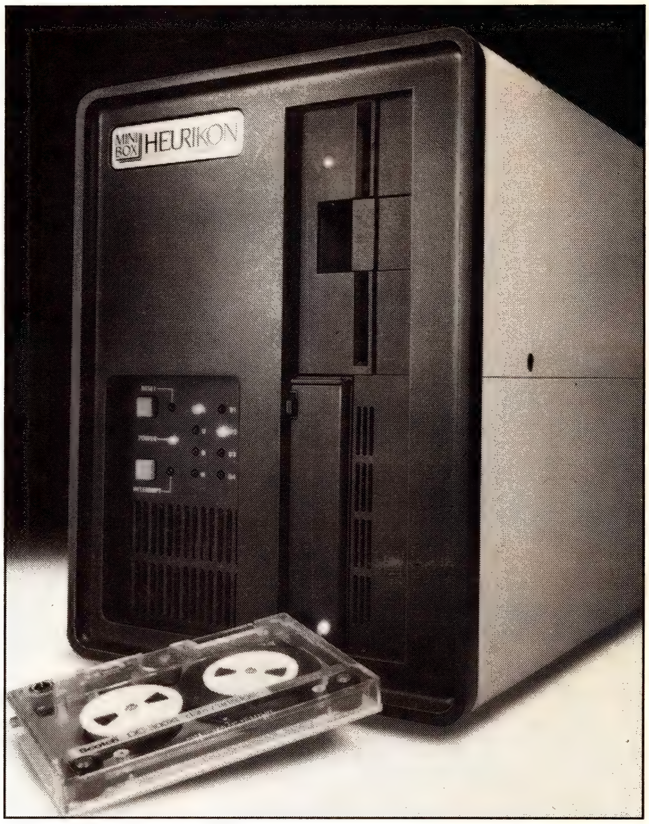
Designed for simplified field or factory installation, the OD9374 single-mode D-3 connector has three parts, as opposed to the typical FC-type connector, which has up to 10 parts. The OD9374, which can be intermated with FC-type connectors, can perform over 1,000 connect/disconnect cycles. Its connecting loss is less than 1 dB.

The connector is intended for primary applications in long-distance transmission and in local-area networks. The manufacturer says that the OD9374 is stable against mechanical and environmental shocks.

The OD9374 fiber-optic connector is available from stock but delivery may take up to 90 days. The price of one connector, fully assembled, is $140.

NEC Electronics Inc., 401 Ellis St., Mountain View, Calif. 94039. Phone (415) 960-6000 [Circle 369]

Small 68010-based system runs Unix System V



A multiuser Unix-based computer system, built around the 68010 microprocessor, comes with a C compiler, six Multibus card slots (five open for expansion), single or dual 5¼-in. floppy-disk drives, 30- to 280-megabyte Winchester disk drive, and an interactive streaming tape drive. The Minibox, as it is called, occupies 1.5 ft^2 of desk space with outside dimensions of 10.5 by 13.9 by 20.5 in. Either Unix System III or System V can be provided.

Features of the Minibox work station include: a four-channel direct-memory-access controller; a Winchester interface; 64-K bytes of erasable programmable read-only memory; up to 1 megabyte of random-access memory; two iSBX expansion connectors; a memory-management unit; four serial input/output ports (which can be expanded to 12); three 16-bit counter-timers; and two parallel ports.

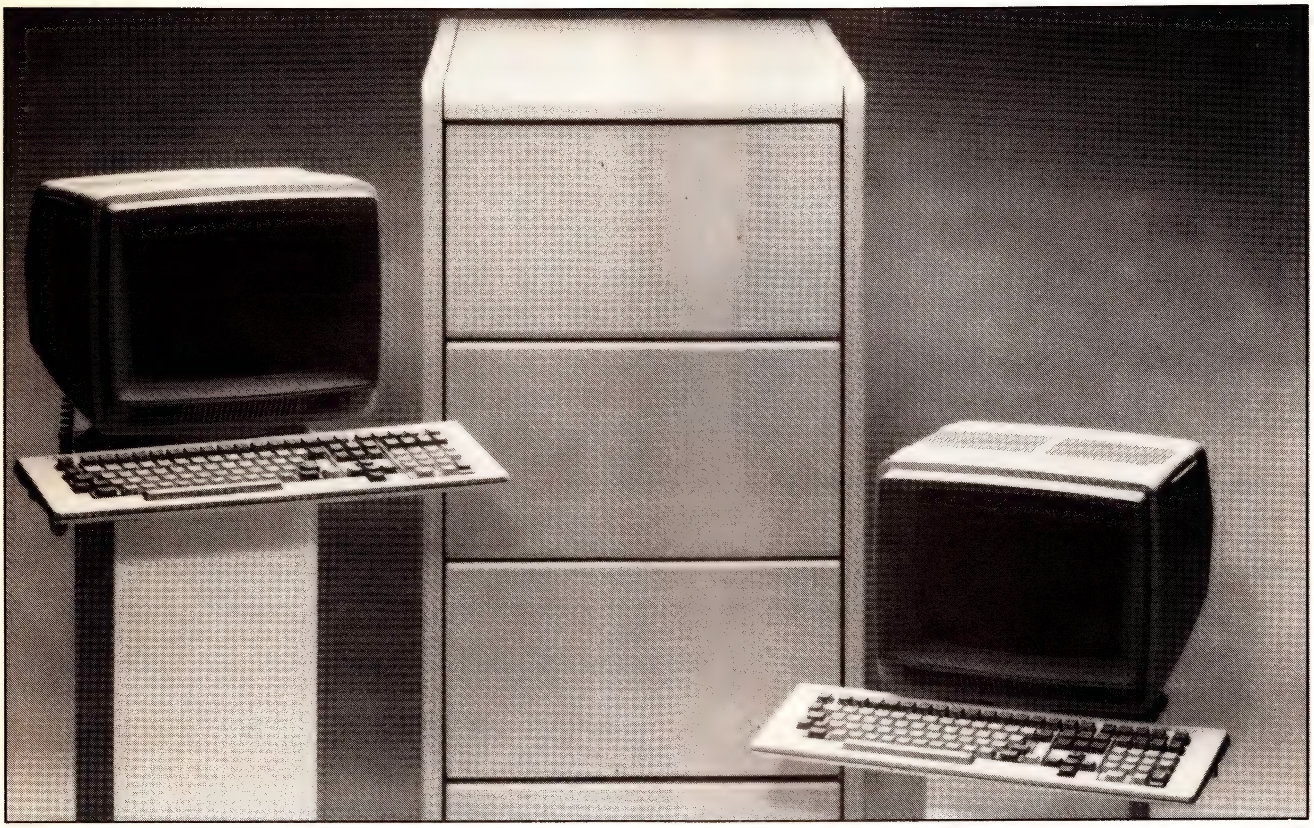
The system has two forward and two rear disk-drive bays. The forward bays hold either one or two 5¼-in. floppy drives, or a 5¼-in. floppy drive and a streaming tape drive. The rear bays hold one or two 5¼-in. hard-disk drives.

Price and delivery information were unavailable at press time.

Heurikon Corp., 3201 Latham Dr., Madison, Wis. 53713. Phone (800) 356-9602; in Wisconsin, (608) 271-8700) [Circle 340]

68020-based Unix system comes in at under $10,000

Powered by the 68010 and 68020 microprocessors and running under the Unix operating system, the Elite series of computers can grow from a 4- to a 64-user system. All models are upwardly compatible and function either as stand-alone units, or with the addition of an Ethernet



controller as a member of a local-area network.

The series' architectures are both VMEbus and Multibus. The Elite 900 uses a 16-MHz 68020 microprocessor; the 700 uses a 12-MHz (or 10-MHz) 68010; the 500, a 10- or 12-MHz 68010; and the 300 a 10-MHz 68010.

The series supports most communications standards and protocols, and each model supports such options as 5¼-in. Qic-2 cartridge tape drives, 5¼-in. floppy disk drives, 5¼-in. hard-disk drives, and 10½-in. streaming or start/stop tape drives. Prices for the systems begin at $9,995.

Brice Systems Inc., 737 Walker Rd., Suite 3, Great Falls, Va., 22066. Phone (703) 759-6100 [Circle 341]

Transceiver chips are full 1,200-baud modems

Housed in a 40-pin dual in-line package measuring 2.25 by 1.0 by 0.5 in., the XE1201 and XE1203 modem synchronous/asynchronous receiver/transmitters (Mosarts) are complete 1,200-baud modems. The Mosarts include a full data-access arrangement to enable direct connection to the telephone line.

This data-access arrangement has been granted Part 68 registration by the Federal Communications Commission, which is transferable to the Mosart user. In addition, the Mosart offers a parallel interface to the host computer, eliminating the need for an additional universal synchronous/asynchronous receiver/transmitter or UART and an RS-232-C serial interface, as would be required to interface to a stand-alone modem.

The Mosart emulates the parallel side of the industry-standard 8251A Usart, enhanced for bus-driving capability. Therefore, it can be connected directly to the host computer's data bus. According to the company, this feature gives the user the full power of the host computer into which the Mosart is designed. Users of currently available smart modems are limited to only the features that reside within the modem itself. The Mosart also offers a telephone-line diagnostics capability that can be used to evaluate and report line quality to the host computer.

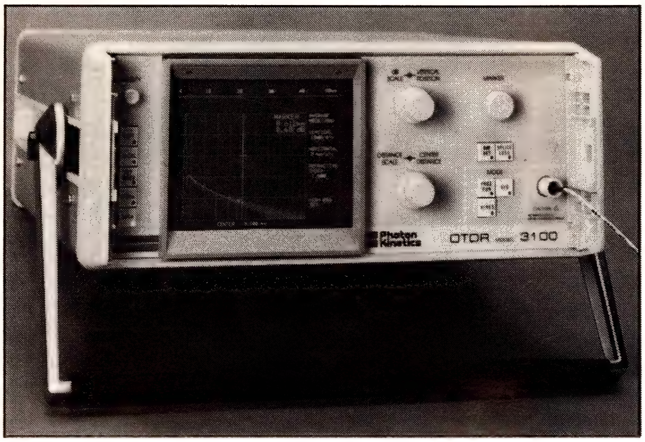
Available now for immediate delivery, the XE1201 sells for $250 each in lots of 100 pieces; the XE1203, which also has voice-synthesis features, sells for $300 each in like quantities.

Xecom Inc., 374 Turquoise St., Milpitas, Calif. 95035.
Phone (408) 943-0313 [Circle 345]

Reflectometer checks single-mode optical fibers

The Photon 3100 single-mode optical time-domain reflectometer features plug-in modules for 1,300- and 1,550-nm wavelengths and provides backscatter measurement in cables with up to 18 dB of loss. The 1,550-nm capability, the manufacturer says, allows the user to take advantage of the inherently lower losses of single-mode fiber at that wavelength to detect faults at longer lengths.

In optical time-domain reflectometry, a laser-generated light pulse is launched into an optical fiber and reflected light is monitored. The reflected waveform is displayed,



providing information on fiber attenuation, splices, and faults.

For field service, the Photon 3100 is said to offer a simplified operator interface. The instrument can also be integrated into laboratory and manufacturing situations with its IEEE-488 interface.

The Photon 3100 is priced at $29,900 with the 1,300-nm plug-in module, or at $34,900 with the 1,550-nm module. Deliveries will begin in March.

Photon Kinetics Inc., 8235 S.W. Cirrus Dr., P.O. Box 1481, Beaverton, Ore. 97005. Phone (503) 644-1960 [Circle 360]

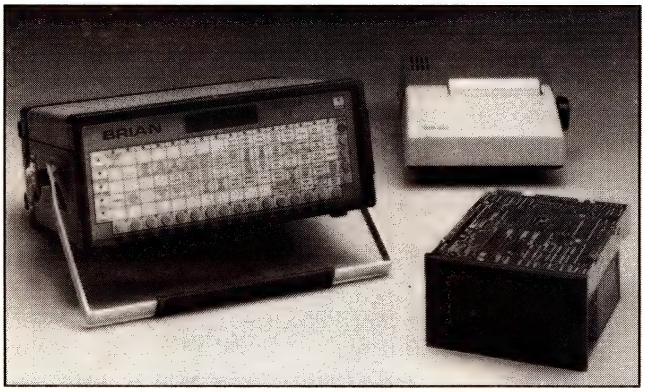
Winchester test analyzer handles 5¼-, 8-in. drives

Using an ST-506 interface, the Hardlign 2.2 Winchester test analyzer performs such functional tests as window margin, asymmetry, overwrite, and floor mapping. An automatic system-test feature permits multiple tests to be performed by means of a single instruction.

An eight-point multiplexer is available for multiple-drive testing. The remote-control option allows test-measurement results to be passed on to a host computer, and the full-duplex capability allows the host computer to manipulate the Hardlign 2.2 in automated factory environments.

The Hardlign 2.2, now available, is priced at under $6,000.

Brian Instruments Inc., 626 S. State College Blvd., Fullerton, Calif. 92631. Phone (714) 992-5540 [Circle 362]



Synthesized signal source operates from 0.01 to 26 GHz

Four programmable synthesized-signal sources that operate from 0.01 to 26 GHz with 1 MHz resolution are said to offer accuracy of 1 x 10^{-6}/yr. Spurious emissions and harmonics are below –55 dBc from 0.05 to 26 GHz. Leveled radio frequency output is +5 dBm or +10 dBm depending on the model. Flatness is ±1 dB to 18 GHz and ±2 dB from 18 to 26 GHz. Maximum output power typically ranges from +5 dBm to +12 dBm.

The instrument series operates on a IEEE-488 interface bus and can be used with all automatic-test-equipment systems, the manufacturer says. Each unit features yttrium-iron-garnet-tuned local oscillators, phase-locked-loop frequency correction, a two-loop indirect-synthesis technique, and down-conversion mixing.

The 4371 operating from 0.01 to 26 GHz with a leveled rf output of +5 dBm is $47,000. Prices will be quoted for other models; all will be shipped in 90 days.

Weinschel Engineering, 1 Weinschel Lane, Gaithersburg, Md. 20877.
Phone (800) 638-2048; in Maryland, (301) 948-3434 [Circle 361]

Chip set combines controller electronics

Designed to control most 5¼- and 3½-in. Winchester disk-drive mechanics, this five-chip set combines drive and controller electronics on a single board with a sub-5¼-in. form factor. The manufacturer believes that this will result in savings to the system integrator, because a single-board solution removes the problems of ST-506 specification variations and the process of mating a drive to a controller.

Initially, the manufacturer will design board products based on the chip set for use with the Winchester disk drives of Tandon, Seagate Technology, and others. Available in the second quarter of this year, board products based on the chip set will also be offered in a complete package that includes drive mechanics. The manufacturer will quote price and shipping information, based on user design.

Western Digital Corp., 2445 McCabe Way, Irvine, Calif. 92714.
Phone (714) 863-0102 [Circle 366]

CMOS arrays boast delays of 2.5 ns/gate

A family of silicon-gate CMOS logic arrays, the six-member PA50000 series, is made in 3-μm CMOS technology. The arrays boast propagation delay times of 2.5 ns/gate. Because of their low power consumption, these logic arrays are said to be capable of replacing Schottky TTL devices in high-speed systems. Also, chip counts can be reduced, the manufacturer says, depending on the density of the PA50000 array used.

All six arrays can be made compatible with either CMOS or TTL and are available in packages with up to 144 pins. Devices can be housed in either plastic or ceramic and are available in either commercial (0° to 70°C) or industrial (–40° to +85°C) temperature ranges.

The manufacturer will quote a price for an array and a delivery time based on custom configuration.

RCA Corp., Solid State Division, Rte. 202, Somerville, N.J. 08876.
Phone (800) 526-2177

Modem filters fit 2,400- or 4,800-b/s applications

Two filters that feature a ±5-V to ±10-V power-supply range, TTL- and CMOS-compatible digital outputs, and uncommitted operational amplifiers meet Bell specifications for 2,400 and 4,800 b/s operation.

The RM5636A integrates four switched-capacitor filters: a receiver bandpass filter that meets International Telegraph and Telephone Consultative Committee V.26/Bell 201 (2,400 b/s) modem specifications; a fixed-compromise delay equalizer with a nominally flat amplitude response (0 dB); a 75/150-b/s secondary channel filter; and a 3-kHz transmit low-pass filter used between the digital-to-analog converter and the phone line.

The first filter of the RM5637A meets CCITT V.27/Bell 208 (4,800 b/s) modem specifications; the other three filters are identical to those used in the RM5636A.

Supplied in a 22-pin package and with uncommitted op amps for user-designated functions (one for the RM5636A, two for the RM5637A), these modem filters are priced at $17.25 and $15.25, respectively, in 100-piece quantities. The company is currently shipping samples.

EG&G Reticon, 345 Potrero Ave., Sunnyvale, Calif. 94086.
Phone (408) 738-4266 [Circle 368]

Switch/spooler serves four computers, two printers

Under the direction of up to four computers, the SX-60 multichannel switch/spooler can feed two printers simultaneously. All switching is software-controlled. Spooler buffers of 8-K bytes, 32-K-bytes, or 64-K bytes store up to 20 pages of text; an expansion board can enlarge buffer capacity to 384-K bytes (120 pages).

The SX-60 will accept serial data on each channel at rates from 150 baud to 19.2 kilobaud, with each computer running at a different baud rate. It is also possible to set each printer at a different baud rate, and various serial-to-serial and parallel-to-serial combinations are available.

The SX-60 multichannel switch/spooler is available for 120 or 220 V ac. Prices start at $469.

Kearsarge Industries Inc., 12310 Pinecrest Rd., Reston, Va. 22091. Phone (703) 620-5760 [Circle 371]

Chip potentiometer occupies little board space

Providing values to 1 MΩ, the series CVR-4 Cermet chip potentiometer features overall dimensions of 0.158 by 0.172 by 0.064 in. The CVR-4 is available with three rotor styles, including one designed for automatic adjustment equipment plus standard clockwise and reverse adjustment. Features include two pad-layout designs and configuration for two or three terminals.

Available in 12-mm tape-and-reel or bulk packaging, the CVR-4 chip potentiometers are priced at 21¢ each in quantities of 10,000. Delivery takes up to eight weeks.

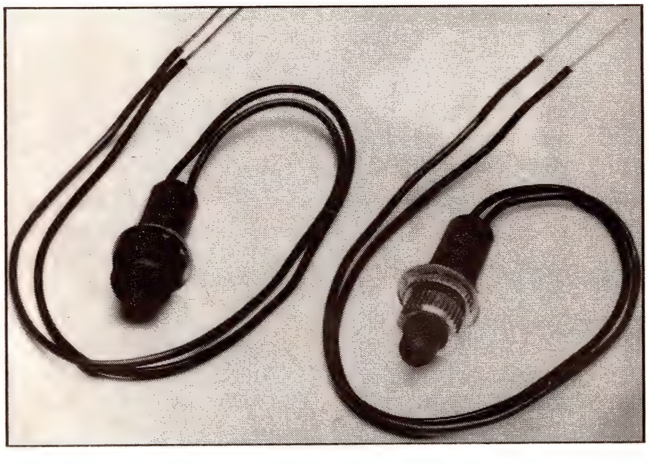
Kyocera International Inc., Surface Mounted Devices, 11425 Sorrento Valley Rd., San Diego, Calif. 92138.
Phone (619) 454-1800 [Circle 373]

LED sockets feature 6-in. flying leads

The PS200 series light-emitting-diode sockets are available with standard 6-in. 24-AWG insulated wire leads. The user may specify other lengths and various colors. PS200 series sockets can be specified with a built-in resistor for LED operation from 5 to 48 V dc. For ac operation below 15 V, these sockets can be used as they come from stock; above 15 V, a built-in rectifier can be specified.

Available in three to five weeks' shipping time, the PS200 series LED sockets are priced at 86¢, in 1,000-unit quantities.

Data Display Products, P.O. Box 91072, Los Angeles, Calif. 90009. Phone (213) 674-5940 [Circle 374]



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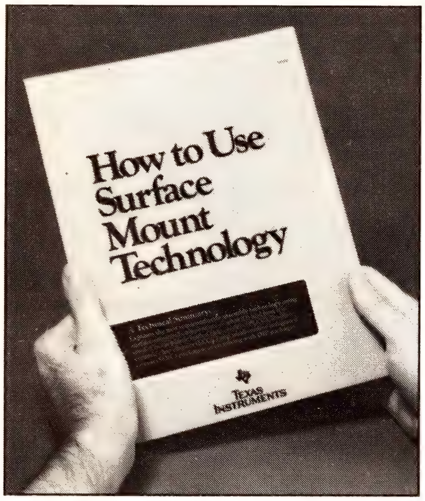
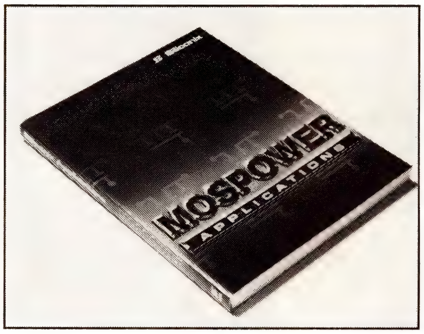


How to do it. Surface-mount technology, including terminology, the connection process, testing, and available products, is covered in *How to Use Surface Mount Technology*. The 112-page manual, which is available free, also discusses the thermal characteristics of surface-mounted-device assemblies and techniques for combining surface-mounted devices and dual in-line packages on the same board. To request a copy (literature no. SSYZ001), write to Texas Instruments Inc., P.O. Box 809066, Dallas, Texas 75380. [Circle reader service number 421]

Design for the times. Software engineers are intensively investigating object-oriented design for large-scale Ada projects. The 225-page *Handbook for Object Oriented Design for Ada Software*, illustrated with diagrams and examples, should reduce the user's reliance on outside consultants, the publisher believes. Until Jan. 31, 1985, a single guide, ordered in quantities of 100, will cost $49.95; thereafter, the price for single copies will be $75. (In Maryland, add 5% sales tax.) Write to Handbook, c/o EVB Software Engineering, 451 Hungerford Dr., Suite 701, Rockville, Md. 20850. Phone (301) 251-1626. [Circle 422]

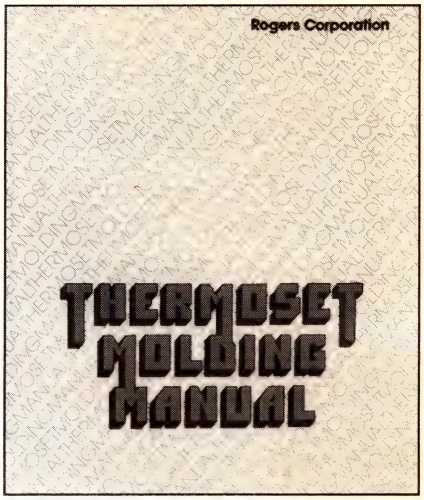
Soft touch. Bulletin 47900 from Lindberg describes the company's model 2291 touch-sensitive screen control system for a conveyor furnace. Functions that can be controlled from the screen include zone temperature, belt speed and gas flow, alarms, and diagnostics. Request a copy of bulletin 47900 from Lindberg, a unit of General Signal, 2450 W. Hubbard St., Chicago, Ill. 60612. [Circle 423]

Fast track. A tracking filter that reduces spurious and harmonic output signals from radio-frequency sources is presented in Application Note FT2. Specifications for three models of closed-loop yttrium-iron-garnet filters are included, covering the 0.5- to 26.5-GHz range. To receive a free copy, call Ferretec Inc. at (408) 263-1216 or write to the company at 1701A Fortune Dr., San Jose, Calif. 95131. [Circle 424]



Tower of power. Designers of power supplies, converters, and the like are offered the *Mospower Applications Handbook*, which covers power MOS FET structures, electrical characteristics, thermal design, device testing, and more. The 512-page volume includes more than 70 articles and application notes from 32 designers of MOS power circuits. Available at $20 per copy, it can be ordered from Siliconix Inc., MS-05, 2201 Laurelwood Rd., Santa Clara, Calif. 95054. Phone (408) 988-8000. [Circle 431]

Hot stuff. The processing, applications, and properties of thermoset allyl, amino, phenolic, epoxy, polyester, and silicone materials are presented in the *Thermoset Molding Manual,* which describes compound specifications including those for the military. Thermoset production methods and equipment are reviewed; the book also covers estimating costs for molds and molded parts. At $10 per copy, it may be ordered from the Rogers Corp. Market Development Manager, Molding Materials Division, P.O. Box 550, Manchester, Conn. 06040, or phone (203) 646-5500. [Circle 426]



Well-connected. Two brochures from Stanford Applied Engineering describe, respectively, the company's DEC-compatible backpanel and its four-slot Versabus. Dimensional data, mechanical and electrical specifications, option descriptions, and more are covered in these publications. Request these by calling (408) 988-0700 or write to the Engineered Products Group, Stanford Applied Engineering, 340 Martin Ave., Santa Clara, Calif. 95050. [Circle 425]

No dumping here. To protect computers and other electronic equipment against the gremlins that masquerade as winter static, 3M has developed Charge-Guard static-protective hard laminate. It is described in a four-page brochure that comes free from the company's Static Control Systems Division, Dept. ST84-22, P.O. Box 33600, 3M Center, St. Paul, Minn. 55133. [Circle 427]

For experimenters. A 3-in.-diameter photomultiplier tube developed for use in high-energy physics experiments, the R1652, is described in a two-page data sheet. The literature supplies specifications, maximum ratings, characteristics, and a dimensional outline. It is available from Hamamatsu Corp., 420 South Ave., Middlesex, N.J. 08846. Phone (201) 469-6640. [Circle 428]

Meetings

1985 Eastern Simulation Conference, The Society for Computer Simulation (P.O. Box 2228, La Jolla, Calif. 94038), Omni International Hotel, Norfolk, Va., March 3-8.

Interface '85, *BusinessWeek* and *Data Communications* (The Interface Group, 300 First Ave., Needham, Mass. 02194), Georgia World Congress Center, Atlanta, March 4-7.

Southwest Conference on Optics, Society of Photo-Optical Instrumentation Engineers (Sue Davis, SPIE, 10800 S.E. Eastmont Dr., Gresham, Ore. 97030), Convention Center, Albuquerque, N.M., March 4-8.

Sixth Symposium on Electromagnetic Compatibility, Swiss Electrotechnical Assocation (T. Dvorak, EH Zentrum-IKT, 8092 Zurich, Switzerland), Federal Institute of Technology, Zurich, March 5-7.

ISDN '85-The Integrated Services Digital Networks Exposition, Information Gatekeepers Inc. (214 Harvard Ave., Boston, Mass. 02134), Bally's Park Place Hotel, Atlantic City, March 6-8.

Fourth International Workshop on Database Machines, Microelectronics and Computer Technology Corp. (Haran Boral, MCC, 9430 Research Blvd., Austin, Texas 78759), Princess Hotel, Grand Bahama Island, March 6-8.

Financial Conference for Emerging Growth Companies, AEA (David McKell, AEA, 2670 Hanover St., Palo Alto, Calif. 94303), Hyatt Regency Monterey, Monterey, Calif., March 6-8 and 11-13.

International Conference on Industrial Automation and First Exhibition on Automation Technology, Hong Kong Productivity Centre (Autotech Hong Kong '85, Hong Kong Productivity Centre, 12/F., World Commerce Centre, 11 Canton Rd., Tsimshatsui, Hong Kong), Hong Kong, March 7-8.

Second Asian-American High-Technology Convention, Asian-American Manufacturers Association and Chinese Institute of Engineers (Regina Lau, Convention Manager, P.O. Box 525, Mountain View, Calif. 94042), San Jose Convention Center, San Jose, Calif., March 9-10.

The Markets for Neodymium-Iron-Boron Magnets, Gorham International (Hugh Olmstead, Gorham International Inc., P.O. Box 8, Gorham, Maine 04030), Holiday Inn Resort, Monterey, Calif., March 10-12.

Symposium on Microlithography, Society of Photo-Optical Instrumentation Engineers (SPIE, P.O. Box 10, Bellingham, Wash. 98227-0010), Santa Clara Marriott Hotel, Santa Clara, Calif., March 10-15.

First Exposition and **Fifth International Seminar on Flexible Manufacturing Systems,** Society of Manufacturing Engineers (SME, 1 SME Dr., Dearborn, Mich. 48121), AMFAC Hotel, Dallas, March 11-13.

National Design Engineering Show and ASME Conference, American Society of Mechanical Engineers (Show Manager, National Design Engineering Show, 999 Summer St., Stamford, Conn. 06905), McCormick Place, Chicago, March 11-14.

Seminars

Computer Operations Management, Pace University (Pace University Midtown Center, 535 Fifth Ave., New York, N.Y. 10017) Pace University Midtown Center, New York, March 7-8.

Data Base Structures and Access Methods Workshop, Control Data Corp. (Institute for Advanced Technology, 6003 Executive Blvd., Rockville, Md. 20852), the Sheraton Conference Center, New York, March 11-15.

Computer Business Graphics, Frost & Sullivan Inc. (Carole Every, Frost & Sullivan Inc., 106 Fulton St., New York, N.Y. 10038), the Inn of Westchester, White Plains, N.Y., March 18-19.

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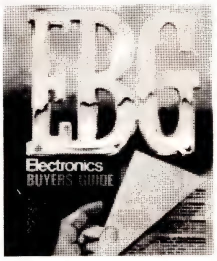

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Like the family friend who nodded sagely and advised "plastics" to Dustin Hoffman as he prepared to face the real world in the 1960s movie, *The Graduate,* so wise adults now whisper "computer science" into the ears of the recently graduated high school students around the world. That advice would appear to be sound. As the developed nations race pell-mell into the information revolution, the need for technocrats who can manage the order of battle is critical.

But that brings up another question, perhaps one that is more basic to the success of the second industrial revolution. In fact, it now seems to be developing that those students, who once might have gone into the plastics industry and who are now rushing into computers, might be advised to listen first to the engineering managers. For they are virtually unanimous in listing as their top need manufacturing engineers, the people who are responsible for seeing that enough products, and enough quality products, get out the door.

As our examination of the situation (see p. 27) points out, the growing intensity of international competition in the electronics business generates along with it an almost insatiable demand for increased productivity. The result can be seen in the engineering colleges: 60 have or are going to have programs to train manufacturing engineers. It seems that the least glamorous discipline in the engineering firmament is gradually beginning to dazzle the onlookers.

And that, naturally, brings up yet another question: who is going to teach the new manufacturing, or applications-oriented, sequences that are sprouting around the country? Our article reports that student-to-faculty ratios of 30 to 1 are not unusual. Not only that, but the Institute of Electrical and Electronics Engineers estimated in 1982 that there were 2,000 engineering-faculty vacancies of all sorts in the U.S.; experts say that the figure is about the same now. So there obviously is no quick-fix solution in sight.

Perhaps, as those interviewed for the article suggest, the answer to the crunch is some sort of corporate involvement in the form of grants of cash and equipment. After all, various programs of company-sponsored campus research are already purring along on many campuses. And such companies as IBM Corp. and Digital Equipment Corp. are already providing help at institutions such as Rensselaer Polytechnic Institute and the Rochester Institute of Technology.

The dream of cooperation between town and gown will probably become reality in one form or another before the millennium. But still another avenue might be taken.

Why don't the colleges, professional societies, and affected companies put together a program to encourage older engineers to use their experience as the foundation for new careers as instructors for the newly popular manufacturing courses? These professionals would need a minimum of retraining, and with some support from industry, the colleges could afford to pay them enough to make teaching attractive.

At the same time, such a program would help put an end to the disgraceful and all-too-prevalent practice of replacing older engineers with new graduates who are lower on the salary scale. It would clothe the whole thing with legitimacy: instead of laying off the older engineers, whose salaries are viewed in many corporate human relations departments as a liability, simply recycle them. That would just be good engineering.

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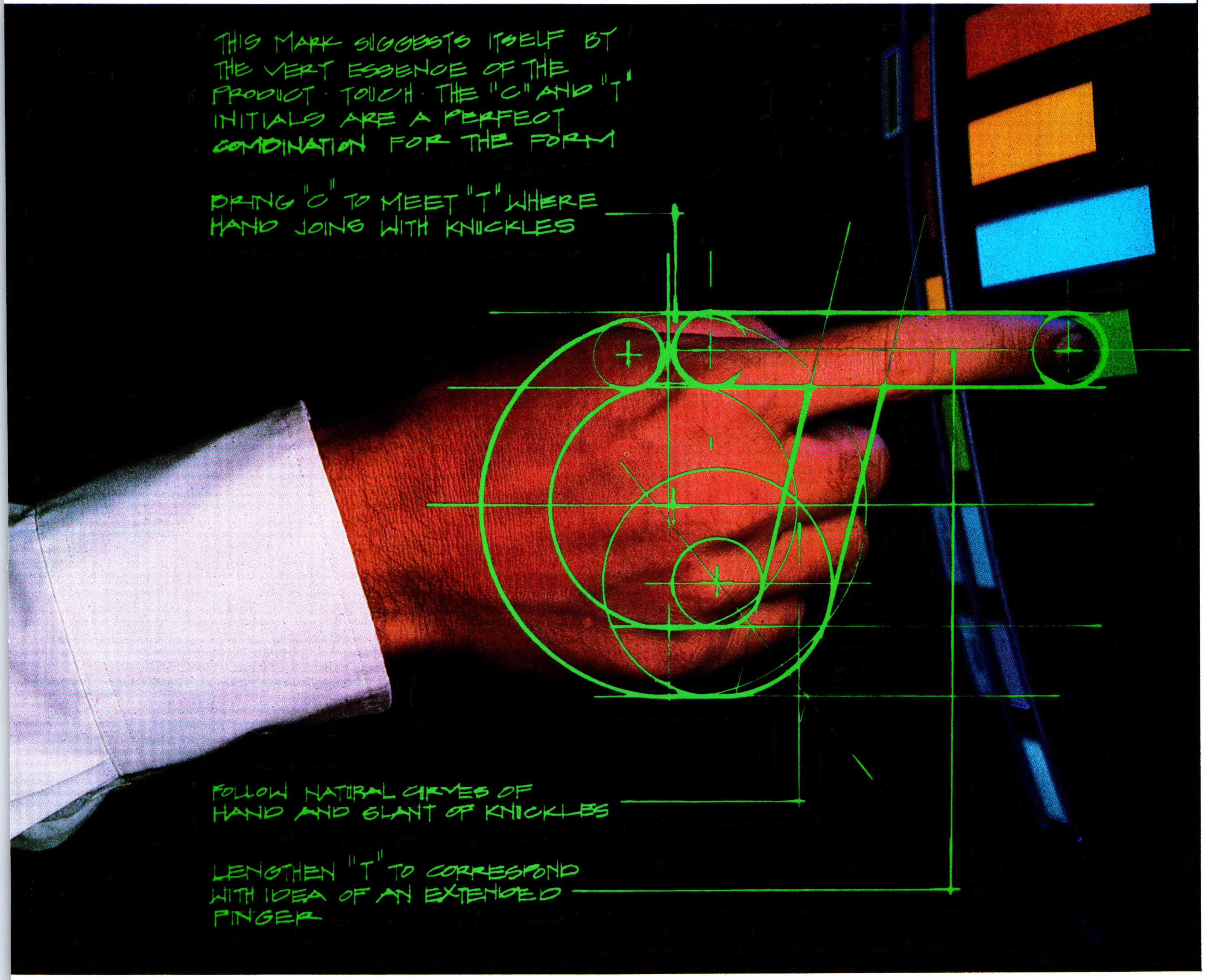
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CPU Cycle	50ns	80ns
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Bus Speed	320 Mbytes/sec	26.8 Mbytes/sec
Memory Expansion	Up to 192 Mbytes	Up to 32 Mbytes
Floorspace	Up to 5 CPUs per 59x32x70″ cabinet	1 CPU per 60x30x74″ cabinet
Operating System	EMBOS/ELXSI UNIX	VMS only

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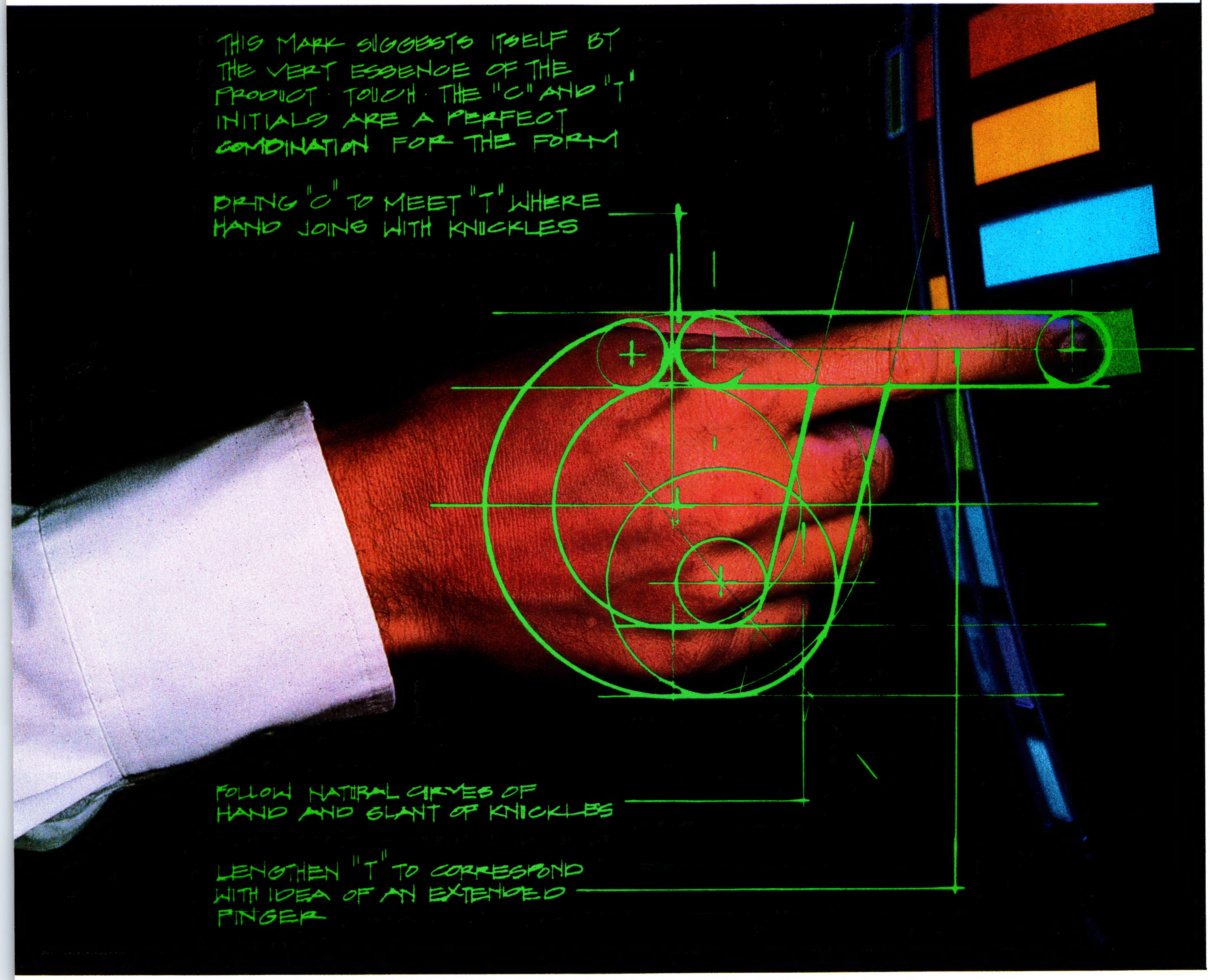
THIS MARK SUGGESTS ITSELF BY THE VERY ESSENCE OF THE PRODUCT · TOUCH · THE "C" AND "T" INITIALS ARE A PERFECT COMBINATION FOR THE FORM
BRING "C" TO MEET "T" WHERE HAND JOINS WITH KNUCKLES
FOLLOW NATURAL CURVES OF HAND AND SLANT OF KNUCKLES
LENGTHEN "T" TO CORRESPOND WITH IDEA OF AN EXTENDED FINGER

Circle 901 on reader service card

WHY WAIT A YEAR FOR THE VAX 8600?

	ELXSI SYSTEM 6400 NOW.	VAX 8600 LATER.
Availability	Now	9 to 12 months ARO
CPUs Delivered	80	None
Price	From approximately $369,000	From approximately $450,000
Performance	6 to 60 MIPS	4 MIPS estimated
Expansion	10 CPUs	Single CPU
Interconnectability	Tightly coupled	Loosely clustered
CPU Cycle	50ns	80ns
Word Size	64 bits	32 bits
Bus Speed	320 Mbytes/sec	26.8 Mbytes/sec
Memory Expansion	Up to 192 Mbytes	Up to 32 Mbytes
Floorspace	Up to 5 CPUs per 59x32x70″ cabinet	1 CPU per 60x30x74″ cabinet
Operating System	EMBOS/ELXSI UNIX	VMS only

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